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Steel Transmission Line Towers

Curves Assumed by Suspended Wires—Theory of the Catenary, the Parabola and the Parabolic Arc with Supports at Different Elevations — Comparison of the Catenary and the Parabola

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This is the second of a series of articles by Mr. Gemmill on steel supports for transmission lines, the first of which appeared in our issue of March 6. In the current article theory pertaining to the curves assumed by suspended wires is given. In the succeeding articles the use of this theory in making sag calculations will be outlined, and later followed by a review of modern practice in the design, spacing and installation of towers.—EDITOR'S NOTE.

When wires are strung from one structure to another throughout a transmission line they assume definite curves between each two of the structures, these several curves, of course, depending upon conditions attending the stringing.

If a heavy uniform string, which is considered to be perfectly flexible, is suspended from two given points, A and B, and is in equilibrium in a vertical plane, the curve in which it hangs will be the common catenary, shown in the accompanying illustration, Fig. 4.

Let D be the lowest point of the catenary, i. e., the point at which the tangent is in a horizontal plane.

Take a horizontal straight line OX as the X axis, whose distance from D we may afterwards choose at pleasure. Draw DO perpendicular to this line and let O be the origin of co-ordinates. Let θ be the angle the tangent at any point P makes with OX. Let T_0 and T be the tensions at D and P, respectively, and let the arc DP $= Z$. The length DP of the string is in equilibrium under three forces, viz., the tensions T_0 and T, acting at D and P in the directions of the

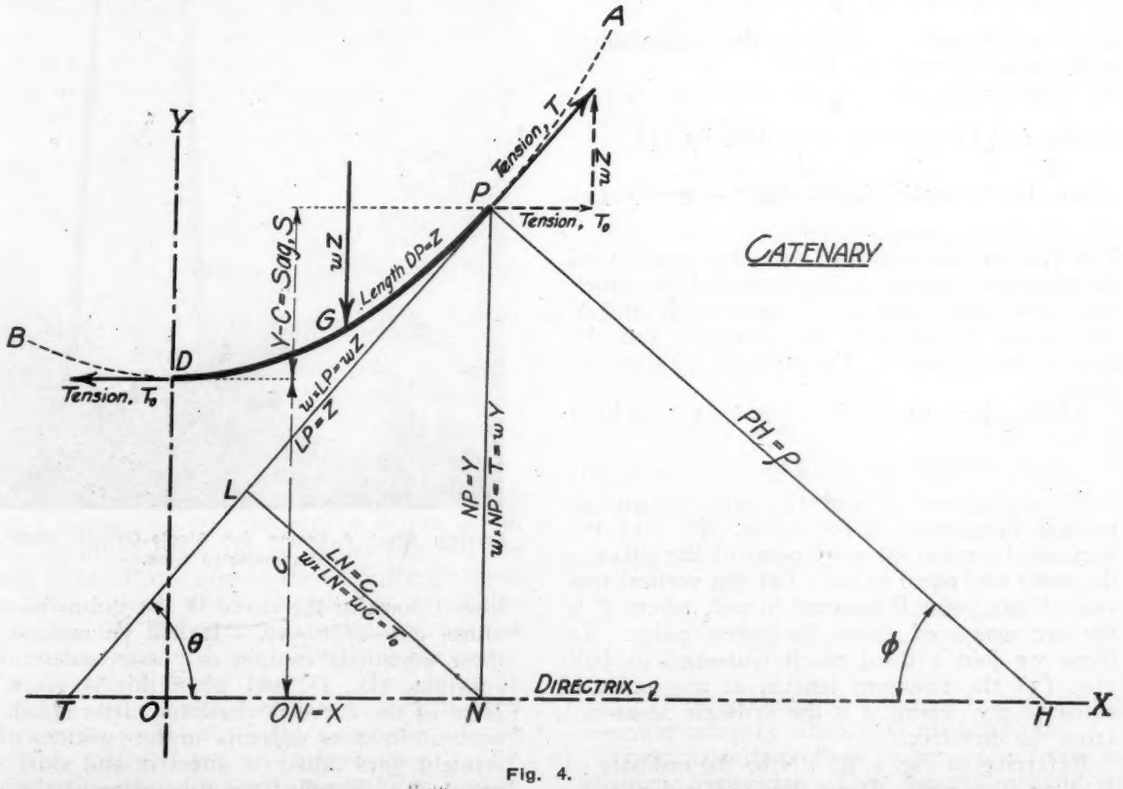


Fig. 4.

arrows, and its weight wZ acting at the center of gravity G of the arc DP.

Resolving horizontally we have

$$T\cos\theta = T_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Resolving vertically we have

$$T\sin\theta = wZ \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Dividing equation (2) by equation (1)

$$dy/dx = \tan\theta = wZ/T_0 \quad \ldots\ldots\ldots\ldots\ldots (3)$$

If the string is uniform w is constant, and it is then convenient to write: $T_0 = wC$. To find the curve we must integrate the differential equation (3).

We have,

$$(dz/dy)^2 = 1 + (dx/dy)^2 = 1 + C^2/Z^2$$

$$\therefore dy = \pm \frac{z\,dz}{\sqrt{Z^2 + C^2}}$$

$$\therefore y + A = \pm\sqrt{Z^2 + C^2}$$

We must take the upper sign, for it is clear from (3) that when x and Z increase, y must also increase. When $Z = O$, $y + A = C$. Hence, if the axis of X is chosen to be at a distance C below the lowest point D of the string, we shall have $A = O$. The equation now takes the form,

$$y^2 = Z^2 + C^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Substituting this value of y in (3), we find,

$$\frac{C\,dz}{\sqrt{Z^2 + C^2}} = dx,$$

where the radical is to have the positive sign. Integrating,

$$C\log\left(Z + \sqrt{Z^2 + C^2}\right) = x + B.$$

But x and Z vanish together, hence $B = C\log C$.

From this equation we find,

$$\sqrt{Z^2 + C^2} + Z = C\mathbf{e}^{x/c}$$

Inverting this and rationalizing the denominator in the usual manner, we have

$$\sqrt{Z^2 + C^2} - Z = C\mathbf{e}^{-x/c}$$

Adding and subtracting, we deduce by (4)

$$y = \frac{C}{2}(\mathbf{e}^{x/c} + \mathbf{e}^{-x/c}), Z = \frac{C}{2}(\mathbf{e}^{x/c} - \mathbf{e}^{-x/c}) \ldots (5)$$

The first of these is the Cartesian equation of the common catenary. The straight lines which have here been taken as the axes of X and Y are called, respectively, the directrix and the axis of the catenary. The point D is called the vertex.

Adding the squares of (1) and (2), we have by help of (4),

$$T^2 = w^2(Z^2 + C^2) = w^2y^2;\ \therefore T = wy. \quad (6)$$

The equations (1) and (2) give us two important properties of the curve, viz., (1) the horizontal tension at every point of the curve is the same and equal to wC; (2) the vertical tension at any point P is equal to wZ, where Z is the arc measured from the lowest point. To these we join a third result embodied in (6), viz., (3) the resultant tension at any point is equal to wy, where y is the ordinate measured from the directrix.

Referring to Fig. 4, let PN be the ordinate of P, then $T = w$PN. Draw NL perpendicular to the tangent at P, then the angle PNL $= \theta$. Hence,

PL $=$ PN $\sin\theta = Z$ by (2)

NL $=$ PN $\cos\theta = C$ by (1)

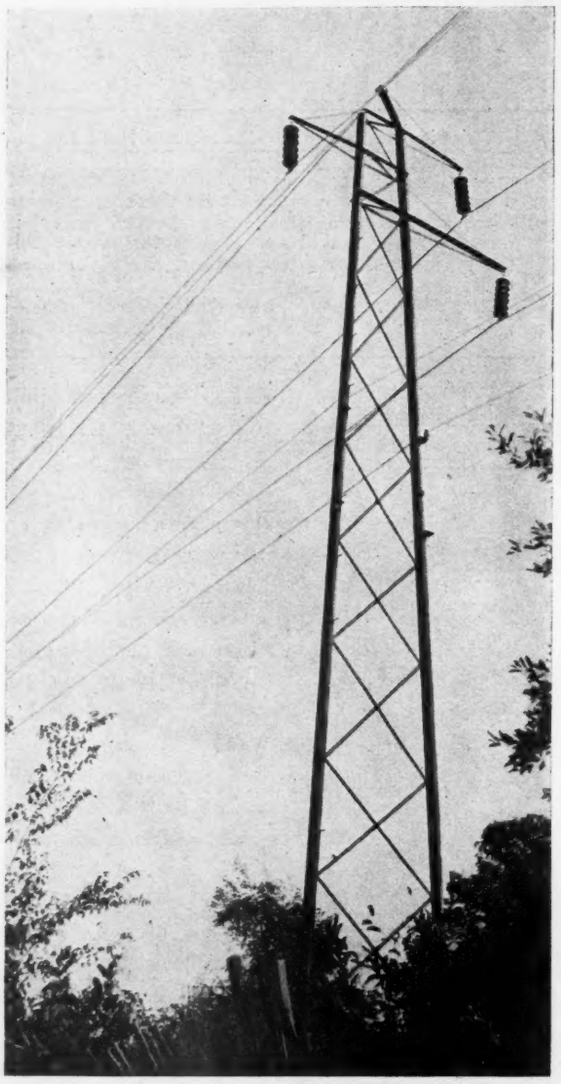
These two geometrical properties of the curve may also be deduced from its Cartesian equation (5).

By differentiating (3) we find,

$$\frac{1}{\cos^2\theta}\cdot\frac{d\theta}{dz} = \frac{1}{C} \therefore \rho = \frac{dz}{d\theta} = \frac{C}{\cos^2\theta} \quad \ldots\ldots (7)$$

ρ is also $= y^2/C$.

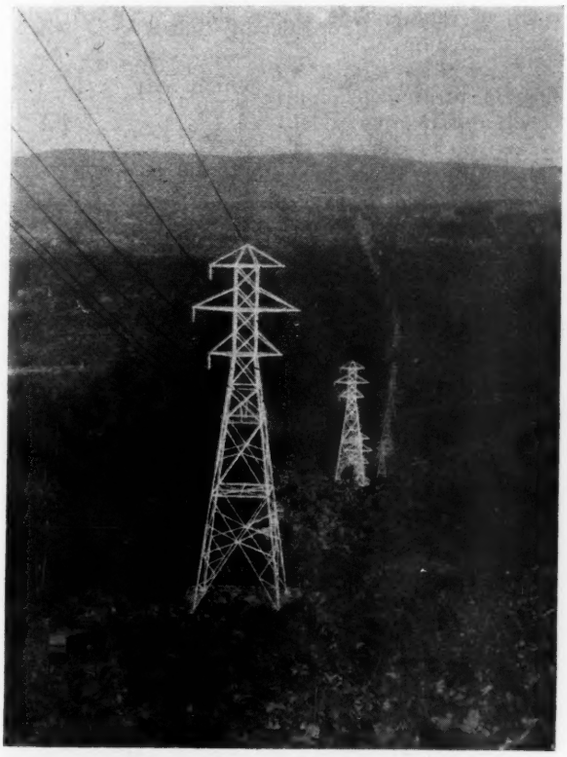
We easily deduce from the right angled triangle PNH that the length of the normal, viz., PH, between the curve and the directrix, is equal to the radius of curvature, viz., ρ, at P. At the lowest point of the curve D, the radius of curvature, $\rho = C^2/C = C$. It will be noticed that these equations contain only one undetermined constant, viz., C; and when this is given, the form of the curve is absolutely determined. Its position in space depends on the positions of the straight lines called its directrix and axis. The constant C is called the parameter of the cate-



Flexible Steel A-Frame for Single-Circuit, 66,000-Volt Transmission Line.

nary. Two arcs of catenaries which have their parameters equal are said to be arcs of equal catenaries.

Since $\rho \cos^2\theta = C$, it is clear that C is large or small according as the curve is flat or much curved near its vertex. Thus, if the string is suspended from two points, A and B, in the same



Rigid Steel Towers for Double-Circuit, 66,000-Volt Transmission Line.

horizontal line, then C is very large or very small compared with the distance between A and B, according as the string is tight or loose.

The relationship between the quantities y, Z, C, ρ and θ and T in the common catenary may be easily remembered by referring to the rectilineal figure PLNH. We have $PN = y$, $PL = Z$, $NL = C$, $PH = \rho$, $T = w$PN, and the angles LNP, NPH are each equal to θ. Thus the important relations (1), (2), (3), (4) and (7) follow from the ordinary properties of a right-angled triangle.

The co-ordinates of the center of curvature for the catenary are:

$$\alpha \text{ (abscissa)} = x - \frac{y}{C}\sqrt{y^2 - C^2}$$

$$\beta \text{ (ordinate)} = 2y.$$

When two or more unequal catenaries have similar outlines so that the ratio $y - C/x$ is the same for all of them, the curvature between the points D and P will also be the same for all these catenaries. From this it follows that, at similar points on the different catenaries the several radii of curvature will vary directly as the values of x for the different curves. The radius of curvature at the lowest point D has already been shown to be equal to C, the parameter of the catenary. Since C and $y - C$ both vary directly as the value of x for these unequal but similar catenaries, it is evident that y must also vary in the same manner. It will be seen from the triangle PLN that when C and y both vary in the same manner, LP or Z, which is the length of the arc DP, must also vary in the same manner.

Elastic Catenary.

When a heavy elastic string is suspended from two fixed points and is in equilibrium in a vertical plane, its equation may be found as follows:

Using the same figures as for the inelastic string and denoting the unstretched length of arc DP by Z_1, let us consider the equilibrium of the finite part DP;

$$T\cos\theta = T_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$T\sin\theta = wz_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\therefore \frac{dy}{dx} = \tan\theta = \frac{wz_1}{T_0} = \frac{Z_1}{C} \quad \ldots\ldots\ldots\ldots (3)$$

From these equations we may deduce expressions for x and y in terms of some subsidiary variable. Since $Z_1 = C\tan\theta$ by (3), it will be convenient to choose either Z_1 or θ as this new variable. Adding the squares of (1) and (2), we have,

$$T^2 = w^2(C^2 + Z_1^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Since $\frac{dx}{dz} = \cos\theta$ and $\frac{dy}{dz} = \sin\theta$, we have by (1) and (2)

$$x = \int \frac{T_0}{T}dz = \int \frac{wC}{T}\left(1 + \frac{T}{E}\right)dz_1$$

$$= \frac{wC}{E}Z_1 + C\log\frac{Z_1 + \sqrt{C^2 + Z_1^2}}{C}$$

$$y = \int \frac{wz_1}{T}dz = w\int \frac{Z_1}{T}\left(1 + \frac{T}{E}\right)dz_1$$

$$= \frac{w}{2E}\left(C^2 + Z_1^2\right) + \sqrt{C^2 + Z_1^2}$$

where the constants of integration have been chosen to make

$$x = O \text{ and } y = C + \frac{C^2 w}{2E}$$

at the lowest point of the elastic catenary. The axis of X is then the statical directrix.

We have the following geometrical properties of the elastic catenary:

$$wy = T + \frac{T^2}{2E} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\rho = \frac{C^2 + Z_1^2}{C}\left(1 + \frac{w}{E}\sqrt{C^2 + Z_1^2}\right) \ldots (2)$$

$$Z = Z_1 + \frac{w}{2E}\left\{Z_1\sqrt{C^2 + Z_1^2} + C^2\log\frac{Z_1 + \sqrt{C^2 + Z_1^2}}{C}\right\} \ldots (3)$$

All of these reduce to known properties of the common catenary when E is made infinite.

These equations have value only from an academic viewpoint. They are too unwieldy to

be of any practical value in determining the properties of curves, assumed by transmission line wires under different working conditions. These equations would be still further complicated if we attempted to make them take care of changes resulting from conditions of loading due to different temperatures.

PARABOLA.

If we consider the weight of the wire to be uniformly distributed over its horizontal projection, instead of along its length, its equation will be found to be that of a parabola.

By referring to Fig. 5 and considering the equilibrium of any part OP of the wire, beginning at the lowest point O, the forces acting on

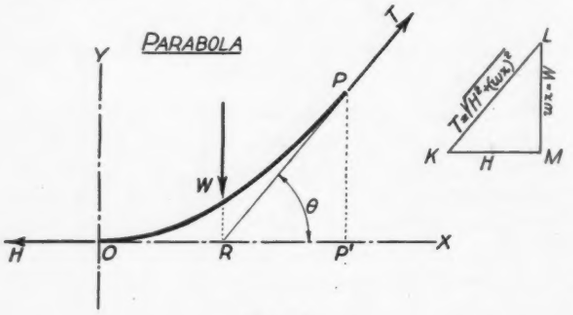


Fig. 5.

this part are seen to be the horizontal tension H at O, the tension T along the tangent at P, and the total weight W of the wire, OP. As this weight is assumed to be uniformly distributed over the horizontal projection $OP^1 = x$ of OP, the weight is $W = wx$, and bisects OP^1.

Resolving the forces in the horizontal and vertical directions, we find as conditions of equilibrium,

$$-H + T\frac{dx}{dz} = O, \quad -wx + T\frac{dy}{dz} = O,$$

whence, eliminating dz, $\frac{dy}{dx} = \frac{w}{H}x$.

Integrating and considering that $x = O$ when $y = O$, we get $y = \frac{w}{2H}x^2$, which may be put in the form $x^2 = \frac{2H}{w}y$. This is the equation to a parabola.

If we substitute $l/2$ for x, and S for y, in the equation for the curve, it becomes $(l/2)^2 = \frac{2H}{w}S$ or $wl^2 = 8HS$, from which $H = wl^2/8S$, which is the well known equation for determining the horizontal tension in the wires, when the two points of support are in the same horizontal plane. In that case $l/2$ equals one-half of the span and S equals the sag or deflection of the wire below the plane of the supports.

The three forces, H, T and W, are in equilibrium; they must intersect at point R which bisects OP^1, and the force polygon must be similar to the triangle RPP^1.

Drawing such a force diagram KLM, and making LM equal to W or wx, and MK equal to H, KL will be the value of T and equal to $\sqrt{H^2 + (wx)^2}$.

Substituting for H and x their values in terms of w, l and S, this becomes $\sqrt{(wl^2/8S)^2 + (wl/2)^2}$
$= \sqrt{(w^2l^4 + 16w^2l^2S^2)/64S^2}$
$= (wl/8S)\sqrt{l^2 + 16S^2}$.

A quantity $\sqrt{A^2 + a^2}$, when a is very small relatively to A, may be approximated by using

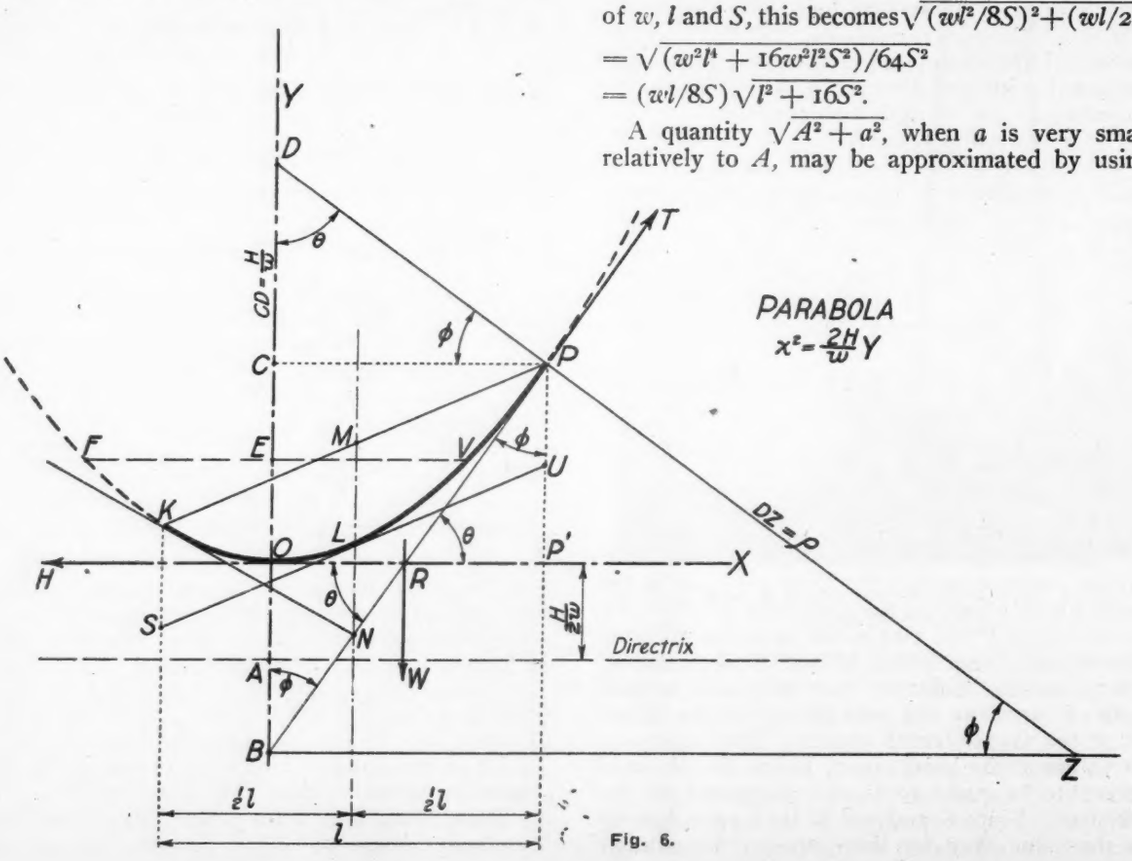
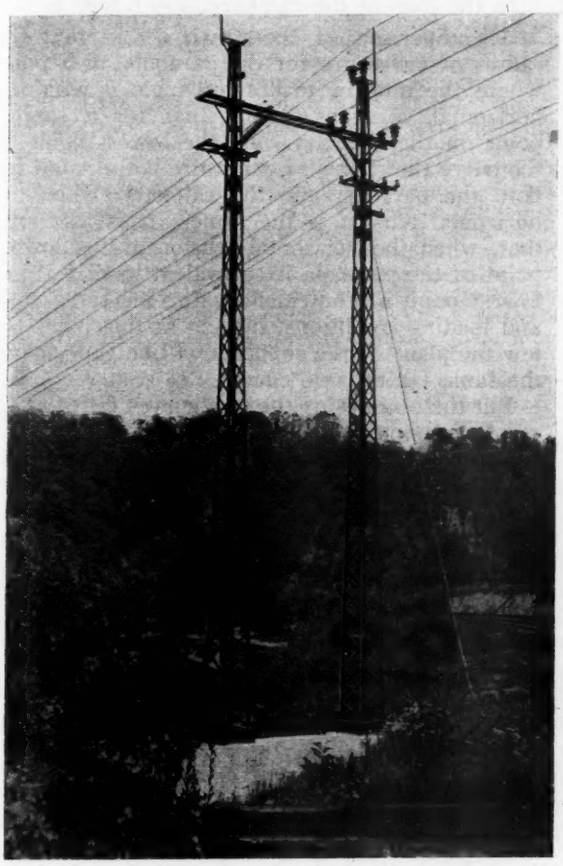


Fig. 6.

$A + a^2/2A$; hence, an approximation for the above value of T is

$$(wl/8S)\ (l + 16S^2/2l), \text{ or } (wl^2/8S) + wS.$$

In this form it is very similar to the expression for the tension in the wire at the insulator supports, derived by assuming the curve to be a catenary. It will readily be seen from the above that for very small sags in short spans the maxi-



Steel Poles for Railroad Crossing of 6,600-Volt Transmission Line.

mum tension at the insulator supports is very little more than the tension at the middle of the span.

But it must be noted that in order that the above assumption may be warranted, it is essential that the span considered be short, and that the length of wire be little more than the span. This, of course, means that the sag in the wire must be rather small.

The equation for the parabola $x^2 = 2Hy/w$ has, for the coefficient of y, a constant which is equal to four times the distance between the directrix of the parabola and the vertex O, as shown in Fig. 6. The directrix is shown passing through the point A and is parallel to the X axis. The line OY is the axis of the curve. If a line is drawn tangent to the curve at any point P, this tangent will intersect the Y axis at a point B, such that the distance BO will equal the distance OC, where C is the point of intersection of the Y axis with a line drawn through the point P, parallel to the X axis. The length BC is the subtangent and is equal to twice the ordinate of the point of contact. The line PD, drawn through the point P and perpendicular to the tangent BP, will intersect the Y axis at point D. The length CD is the subnormal of the curve and is constant for all points on the curve. It is equal to one-half the coefficient of y in the original equation and is therefore equal to H/w. The angles TRX and ORB are each equal to the angle PDC or θ.

$$\tan\theta = P^1P/RP^1 = y/\tfrac{1}{2}x = 2y/x.$$

Parabolic Arc with Supports at Different Elevations.

The curve in which a suspended wire hangs may be considered to extend indefinitely in both directions, and the suspended wire may be secured to rigid supports at any two points, such as N and U, lying on this curve (Fig. 7) without altering the tension in the wire. The law of this parabola is

$$x^2 = Ky,$$

and in the case of a suspended wire the multiplier K is directly proportional to the tension H, and inversely proportional to the density of the conductor material. The value of K in terms of the horizontal tension and the weight of the conductor has already been found to be $2H/w$.

Let S = sag below level of lower support,
B = horizontal distance of lowest point of wire from lower support,
h = difference in level of the two supports,
l = length of span measured horizontally,

all as indicated on Fig. 7; then, by inserting the required values in equation $x^2 = Ky$, the following equations are derived therefrom:

$$B^2 = KS,\ (l - B)^2 = K(S + h), \text{ or}$$
$$l^2 - 2lB + B^2 = KS + Kh,$$

from which B^2 on one side and its equivalent KS on the other side cancel out, leaving $l^2 - 2lB = Kh$.

Therefore,

$$B = (l^2 - Kh)/2l, \text{ and } S = B^2/K.$$

From an inspection of the above it is seen that if $Kh = l^2$, the lowest point of the wire coincides with the lower support N, while if Kh is greater than l^2, the distance B is negative, and there may be a resultant upward pull on the lower insulator N—a point to bear in mind when considering an abrupt change in the grade of a transmission line.

We may consider the curve of the wire between the two supports N and U as being made

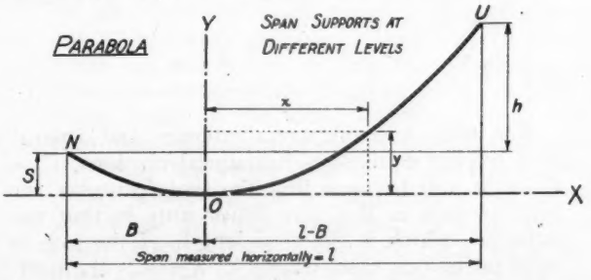


Fig. 7.

up of two distinct parts, NO and OU. The part NO will be equivalent to one-half of a curve whose half span measured horizontally is B and whose sag is S. Similarly, the part OU will be equivalent to one-half of a curve whose half span measured horizontally is $l - B$, and whose sag is $S + h$.

It is possible and sometimes convenient, to

express the formulas for wires suspended from supports not at the same level, in terms of the equivalent sag (Se) of the same wire, subjected to the same horizontal tension when the horizontal span (l) is unaltered, but the supports are on the same level.

For such a condition, the equation to the curve becomes

$$(l/2)^2 = KSe,$$

from which

$$K = l^2/4Se.$$

If we substitute for K in the above formulas, its equivalent value, $K = l^2/4Se$, then we get the following set of formulas, in which B, S, l and h are all as indicated in Fig. 7.

$$B = \frac{l}{2}\left(1 - \frac{h}{4\,Se}\right), \text{ or, } l - B = \frac{l}{2}\left(1 + \frac{h}{4\,Se}\right)$$

$$S = Se\left(1 - \frac{h}{4\,Se}\right)^2, \text{ or, } S + h = Se\left(1 + \frac{h}{4\,Se}\right)^2.$$

COMPARISON OF CATENARY AND PARABOLA.

If a straight line is drawn through the point P and any other point K on the parabola, shown in Fig. 6, and this chord KP is bisected at the point M, a line drawn through this point M and parallel to the Y axis will bisect all other chords which are parallel to the chord KP. From this it follows that a line SU drawn tangent to the parabola and parallel to the chord KP will be tangent to the curve at a point L which lies on a line that is drawn parallel to the Y axis and through the point M. Another property of the parabola is that the tangents to the curve at the points K and P will intersect at the point N, which also lies on the line that passes through the points L and M. If the horizontal projection of the chord KP be designated by l, then the horizontal projection of KM, MP, KN and NP will each be equal to $\frac{1}{2}l$.

The total tension T in the wire at any point on the curve equals

$$\sqrt{H^2 + (wx)^2},$$

or,

$$T = w\sqrt{(H/w)^2 + x^2}.$$

But it is seen from the figure that

$$\sqrt{(H/w)^2 + x^2} = \text{DP},$$

$$\therefore T = w \times \text{DP}.$$

In the case of the catenary the total tension in the wire is

$$T = wy$$

in which

$$y = \sqrt{C^2 + Z^2}$$

But, when we compare a catenary and a parabola having equivalent horizontal tensions, $C = H/w$, it will be seen that the two formulas for total tension in the wire differ only in that the value Z, which is the true length of the arc, is used in the one case, where X, which is the horizontal projection of the length, is used in the other. But T will always be greater for the catenary except at the lowest point of the curve.

The radius of curvature of the parabola $x^2 = 2HY/w$ is $\rho = (H/w)/\sin^3\phi$, in which ϕ is the angle which the tangent to the curve makes with the Y axis.

$\rho \sin^3 \phi = H/w = \text{DP} \sin \phi$, or, $\rho \sin^2\phi = \text{DP}$ from which

$$\rho = \text{DP}/\sin^2\phi = \text{DZ}.$$

$$\frac{\text{BD}}{\text{DZ}} = \sin\phi, \text{ or } \frac{\dfrac{2y + H/w}{\rho}}{} = \sin\phi.$$

$$\rho = \frac{2y + H/w}{\sin\phi} = \frac{2y + H/w}{\cos\theta}$$

If we substitute C for H/w, the radius of curvature is $\rho = C/\sin^3\phi = C/\cos^3\theta$.

In the case of the catenary, $\rho = C/\cos^2\theta$.

A comparison of these two shows that the radius of curvature for the parabola, at a point where the tangent makes an angle θ with the horizontal, is $1/\cos\theta$ times that for a similar point on the catenary. At the lowest point of the curve the radius of curvature is the same for both the parabola and the catenary, when the horizontal tension is the same. It is also true that, when the horizontal tension at the lowest point of the parabola is equivalent to that at the lowest point of the catenary for the same span and loading conditions, the sag at this point below the plane of the supports will be very nearly the same for the two curves.

But the outlines of the two curves differ at all points between the lowest point and the point of support. This difference between the outlines of the two curves becomes greater as the spans and the sags are made larger. It is because of this difference in the outlines of the two curves that the sags will be nearly equal for only one loading condition. Any change in the loading condition will produce different changes in the lengths of the two curves, and hence, will make the sags different.

WILL DESCRIBE SYSTEM OF STATIC ELIMINATION TO RADIO MEN.

Interesting information in regard to United States government radio work will be given the Institute of Radio Engineers at their meeting to be held April 7 at the Engineering Societies building, New York City. Dr. Louis W. Austin, head of the U. S. Naval radio telegraph laboratory, Washington, will read a paper on "The Reduction of Atmospheric Disturbances in Radio Reception," in which the system of static elimination used at Bar Harbor, Belmar, Lakewood, Anacostia and other big stations for transoceanic reception will be described and comparisons of their operation given.

SUMMER MEETING OF THE A. I. C. E. WILL BE HELD IN CANADA.

Canada will be visited this summer by the American Institute of Chemical Engineers during the annual midyear meeting. The dates tentatively selected are June 21 to 26. Plans include a two-day business session at Montreal and a visit to Montreal's chemical industries. A trip will be made to Shawninigan Falls for inspection of the power development and electrolytic industries in that vicinity.

OHIO PASSES "WHITE WAY" LAW.

The Ohio legislature has passed a law which permits municipalities to assess all or part of the costs of "white way" lighting on the owners of abutting property.

Data on Rural Line Extensions

Results of Investigation of Representative Rural Line Installations in Wisconsin, with Draft of Rules Formulated for the Proper Handling of Rural Service by Central-Station Companies

On Nov. 21, 1919, the Railroad Commission of Wisconsin held a conference on the subject of extensions of rural electric lines, the discussion showing the need of developing a definite policy regarding such extensions. Suggestions were made that the Railroad Commission co-operate with the Wisconsin Electrical Association and the outcome was the appointment by the latter organization of a Committee on Rural Line Extensions, with G. C. Neff, Wisconsin Power & Light Co., Madison, as chairman. A number of conferences were held and investigations were made of representative rural line extensions, data being obtained on installation costs, operating conditions and income received by the utility companies for such service. This information was tabulated.

A study of the tables and other information presented shows that in nearly every case the revenue obtained from the extensions was not sufficient to yield a fair return to the utility, even though in some cases the consumers have contributed somewhat to the cost of the line and have paid rates somewhat higher than city rates.

To remedy this situation the committee drafted a set of rules covering the handling of rural service by central-station companies and, with the results of the investigation, were presented in the report to the association.—EDITOR'S NOTE.

It is evident that if a utility company finances a rural extension entirely its rates for service need to be exceedingly high. Such high rates per kw-hr. and heavy monthly charges tend to discourage the farmer in continuing and increasing his use of the service. Furthermore, utilities in general are not in financial condition to finance extensive rural lines, whereas rural consumers are generally well able and willing to finance the construction of lines to serve them. Farmers invariably want electric light and power service and see the decided advantages in obtaining central-station service. In this way they are provided service practically on city standards with no effort or responsibility on their part. They also realize that not only lighting service but power service can be obtained.

FARMERS WILLING TO PAY INSTALLATION COST OF EXTENSIONS.

Farmers are invariably willing to contribute to the cost of an extension in preference to purchasing farm lighting plants. The latter cost approximately $600 and this amount will ordinarily more than cover a farmer's portion of the cost of a farm line extension. If the farmer finances the extension, the monthly charge for service is reduced correspondingly and the farmer becomes a permanent consumer.

For these reasons it is evident that farmers' lines, exclusive of the necessary watt-hour meters, should be financed wholly by the consumers.

Rural extensions are made to serve such widely varying territory that it seems futile to attempt to develop a rate which can justly be applied to all rural lines served or to be served by a single central-station company. The district covered by each rural extension should be considered as a unit and have a rate which is fair for that district. As the urban business is generally the major part of a utility business, it may be assumed that the rates and rules applying to the same are equitable. It follows that these same rates and rules should be applied as far as practicable to the rural service of each utility. Investigations have shown that urban rates will generally be insufficient even though the entire cost of the rural extension has been borne by the consumers. It is therefore necessary to make up the deficiency by an additional charge which is made a part of rural rate proposed.

The proposed rate is made up of two parts: (1) The regular rates charged for service in the adjacent urban community, and (2) a rural charge.

The latter represents the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding items for city service. In comparing these items for rural and city service, it seems best to make comparisons of expenses on the basis of equal incomes.

INVESTIGATION OF RATES IN WISCONSIN CITIES.

An investigation covering 25 cities in Wisconsin shows an investment in distribution system equal to approximately twice the annual revenue. City rates are presumed to provide for all operating expenses plus an allowance for fixed charges equal to 13.5% on the investment, or in other words, approximately 13.5% of twice the annual income. (The 13.5% fixed charges consist of 8% return, 4% depreciation and 1.5% taxes.)

Therefore, in any given annual revenue calculated at city rates, there is presumed to be included an allowance of 13.5% for fixed charges on an investment in distribution system equal to twice the annual revenue. Therefore rural consumption calculated at city rates includes the above amounts and the rural consumer should be given credit in the rates for this amount. As this plan contemplates that the rural consumer will bear the entire cost of the extension, the utility is not entitled to earn interest on the investment. It should, however, earn an amount equal to 10% of the investment made up as follows: 2% is considered as the difference between an 8% return and a normal interest rate of 6%, and represents payment to the utility for the hazard of constructing the business. In addition the utility should earn 4% for depreciation and 1.5% for taxes. The utility should further earn an amount sufficient to cover excess maintenance and operating costs.

It is difficult to obtain complete information regarding these excess costs of maintaining and operating rural lines, as compared with city lines,

because most accounting systems do not segregate these items. However, from the available information it is evident that these costs are considerable. Maintenance of lines, meters and transformers, removal and resetting of transformers and meters, inspection of transformers, inspection and testing of meters, reading of meters and trouble service, all involve far greater expense on rural lines than on city distribution systems. It is estimated that 2½% of the cost of the extension should be earned annually to go toward paying these items.

The energy losses in rural distribution are excessive as compared to the losses in city distribution. It is assumed that the total primary loss, transformer copper loss and secondary loss in rural service is equal to the combined primary loss, transformer core and copper loss and secondary loss in city distribution.

The excess energy loss in rural distribution is considered equal to the total core losses of all transformers used in supplying the rural service. This core loss is a steady load and should ordinarily earn a low rate excepting for the fact that its power-factor is low, probably about 45%. The charge for this core loss energy should be computed at the utility's power rate.

On the basis of the foregoing discussion, the use of the following rules for rural extensions was recommended.

Rules for Rural Extensions.

1. *Rural Extensions Defined.*—Rural extensions shall include all extensions to distribution systems, built primarily to serve consumers located outside the corporate limits of cities or villages or other territory which has the character and density of population similar to urban conditions.

2. *Cost of Extension Defined.*—Estimated construction cost shall include all material, labor and other expense required for the distribution and installation of poles, wire, crossarms, insulators, line hardware, switching and protective devices, transformers, appurtenances, right-of-way permits, etc. Metering equipment shall be supplied by the utility and cost of same shall not be included in the estimated construction cost.

An item not exceeding 10% of material cost shall be included to cover purchasing expense, freight, cartage to storeroom and stores—department expense.

An item not exceeding 15% of all above mentioned items shall be included to cover general overhead, engineering, promotion, office supervision, clerical labor, contingencies, etc.

3. *Analysis of Extension.*—When one or more prospective rural consumers make application for electric service the utility will investigate the extension, ascertain the number of consumers who can be advantageously served, the number who will contract for service under the terms herein prescribed and will estimate the construction cost as outlined in Rule 2.

4. *Payments by Consumers.*—When the prospective consumers shall have paid to the utility the estimated construction cost of the extension the utility will construct the extension and render service. If the actual construction cost exceeds the estimated construction cost, each prospective consumer shall, upon demand, pay a part of the difference in proportion to the amount originally advanced. If the actual construction cost is less than the estimated construction cost the utility will refund the difference to the consumers in proportion to the amount advanced.

5. *Connection Charge.*—Before service is rendered from an extension a connection charge shall be filed with the Railroad Commission of Wisconsin, which charge shall be applicable to additional rural consumers desiring connection to the extension subsequent to the consummation of the original agreement. This connection charge shall be determined by dividing the actual construction cost of the extension by the number of original consumers.

If an additional consumer desires connection to an extension and can be connected in such a manner that the estimated cost of the line extension required is less than the connection charge, the consumer shall pay the connection charge to the utility and the utility shall connect the additional consumer and render service. The difference between the actual cost of the line extension required to serve the additional consumer and the connection charge paid by the additional consumer shall be refunded to the consumers, including the additional consumer, in proportion to the total amounts paid towards the construction cost. In case an additional consumer desires connection to an extension and the estimated construction cost of the required extension is greater than the connection charge, the consumer shall pay to the utility the actual cost of the extension instead of the connection charge and no refunds will be made to the original consumers.

In case an urban consumer is connected to a rural extension in such a manner that the actual cost of connection is less than the free limit as defined in the urban rules of the utility, then the difference between the urban free limit and the cost of connection of the additional urban consumer shall be refunded to the original rural consumers in proportion to the amounts advanced.

6. *Rates.*—The rates for rural service shall be (a) a rural charge plus (b) the regular urban rates.

The rural charge shall cover the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding items for city service. The annual rural charge for the extension shall be equal to 10% of the total construction cost of the extension plus the total transformer core losses per year computed at the utility's power rate minus 13½% of two times that part of the annual revenue from the extension which is computed at the regular urban rates.

The annual rural charge of the individual consumers will then be determined as follows: 50% of the total annual rural charge shall be apportioned equally among the consumers, and 50% of the total annual rural charge shall be apportioned among the consumers according to installed transformer capacity. In case two or more consumers are served from the same transformer the installed transformer capacity for

each consumer shall be considered as the estimated portion installed for the requirements of each individual. One-twelfth of the annual rural charge so apportioned to each consumer shall be billed monthly by the utility and paid by the consumer as the monthly rural charge.

In addition to the rural charge the consumer shall pay the regular rates charged for service in the adjacent urban community where the extension originates. This charge will include all minimum service and demand charges which are a part of the urban rates.

7. *Annual Adjustment in Rural Charge.*—Adjustments will be made in the rural charge at the end of each calendar year to allow for changes in the number of consumers, changes in revenue from line, changes in transformer capacity, etc., and the rural charge then fixed shall be effective for the following calendar year.

8. *Combined Transmission Line and Rural Extensions.*—In case the rural extension is constructed for use partly as a transmission line to some large consumer, city, village or hamlet, and the business to be derived from the use of the extension as a transmission line is inadequate to justify the construction of the extension without a portion of the cost being paid by rural consumers, the matter shall be referred to the Railroad Commission of Wisconsin for determination as to the fair apportionment of costs in case of failure of the parties involved to agree.

9. *Title to Extension.*—The title to all exten-

TABLE NO. 1.—CHARACTERISTICS OF FARM LINES FOR SUPPLYING CENTRAL-STATION SERVICE.

Extension No.	Date of construction.	Length in miles.	Cost per mile when built.	No. of consumers.	Poles—predominating size.	Poles—average per mile.	Primary wire, size.	Primary wire, material.	Voltage.	Phase.	Transformers connected, Kv-a.	Kw-hr. sold per year.	Annual income from extension.	% of construction cost borne by consumer.
1	1916	2.0	$ 929	9	25' 6"	44	6	Copper	2,300	1	16.0	3,782	$ 436	19
2	1908	1.0	920	8	25' 5"	53	10	Copper	2,300	1	16.5	1,671	190	100
3	1912	1.1	604	5	25' 5"	53	10	Copper	2,300	1	15.0	1,197	140	100
4	1913	0.9	555	2	30' 5"	70	10	Copper	2,300	1	10.0	1,279	141	100
5	....	12.0	951	39	25' 6"	50	6	Copper	2,300	3	29.5	7,420	776	23
6	....	1.5	1,033	7	25' 6"	42	8	Copper	2,300	1	6.0	1,650	160	16
7	....	2.0	1,123	8	25' 6"	44	6	Copper	2,300	1	11.0	1,720	199	51
8	....	3.0	483	17	25' 6"	40	8	Copper	2,300	1	15.5	4,439	356	34
*9	....	....	...	6	25' 6"	44	6	Copper	2,300	3	10.5	3,740	277	...
*10	....	....	...	9	30' 6"	50	4	Copper	6,600	3	17.5	2,520	261	...
11	1918	2.0	781	6	25' 6"	39	3No.10	BB Iron	2,300	1	15.0	1,769	178	89
†12	1917	13.0	655	25	25' 6"	35	3No.10	BB Iron	6,600	3	47.0	18,000	1,800	...
13	....	1.0	1,530	5	25' 6"	44	10	Copper	6,600	1	5.0	1,126	96	36

TABLE NO. 2.—UNITS DERIVED FROM TABLE NO. 1.

Extension No.	Per Mile			Per Consumer					Income.
	Construction cost per mile.	Income per year per mile.	Consumers per mile.	Construction cost per consumer.	Income per year per consumer.	Kv-a. transformer capacity per consumer.	Kw-hr. sold per year per consumer.	Average connected load in Kw. per consumer.	Ratio of investment to annual income.
1	$ 929	$218	4.5	$206	$48	1.7	420	1.3	$ 4.35
2	920	190	8.0	115	24	2.0	209	2.3	5.00
3	604	128	4.5	133	28	3.0	239	1.3	4.75
4	555	157	2.2	250	71	5.0	639	3.0	3.57
5	951	65	3.2	293	20	0.8	190	...	14.93
6	1,033	107	4.6	225	23	0.8	235	...	7.68
7	1,123	80	4.0	281	20	1.4	215	...	14.10
8	483	119	5.6	85	21	0.9	261	...	4.17
*9	...	65	1.4	...	46	1.7	623	...	....
*10	...	26	0.9	...	29	1.9	280	...	....
11	781	89	3.0	260	29	2.5	271	...	9.09
†12	655	138	1.9	341	72	2.3	382	...	4.75
13	1,530	192	5.0	306	19	1.0	225	...	15.95

TABLE NO. 3.—APPLICATION OF PROPOSED PLAN OF RURAL EXTENSION OF WISCONSIN ELECTRICAL ASSOCIATION TO THE THIRTEEN EXTENSIONS LISTED ABOVE.

Extension No.	Total construction cost.	Annual rural charge.	Billings at urban rate.	Total annual income on proposed basis.	Average monthly rural charge per consumer.	Average monthly billing at urban rate.	Total average monthly payment for service.	Average price per Kw-hr. proposed plan.
1	$ 1,858	$110	$436	$546	$1.02	$4.03	$5.05	$0.144
2	920	123	132	255	1.28	1.38	2.66	0.152
3	665	98	98	196	1.63	1.63	3.26	0.164
4	500	63	98	161	2.62	4.08	6.70	0.126
5	11,414	995	776	1,771	2.13	1.66	3.79	0.239
6	1,550	130	160	290	1.55	1.91	3.46	0.176
7	2,246	204	160	364	2.13	1.67	3.80	0.211
8	1,450	79	356	435	0.39	1.74	2.13	0.098
*9	480	—2	277	275	0.03	3.84	3.81	0.073
*10	1,265	107	261	368	0.99	2.42	3.41	0.146
11	1,562	163	178	341	2.26	2.48	4.74	0.192
†12	8,520	560	1,890	2,360	1.87	6.00	7.87	0.131
13	1,530	138	96	234	2.30	1.60	3.90	0.208

*Rural consumers connected to transmission lines.

†Rural stock company—several assumptions necessary to complete analysis.

Note—Present construction costs will be approximately 40% higher than costs shown.

Note—A negative value for rural charge could be eliminated and discrimination avoided by the company bearing the proportion of construction expense necessary to make rural charge zero.

sions toward which consumers have advanced money shall remain with the utility.

10. *Extensions from High-Voltage Transmission Lines.*—Rural extensions from transmission lines of over 15,000 volts may be considered special by the utility.

11. *Access to Consumer's Premises.*—The utility shall have the right at all times to examine the apparatus and material placed by it on the premises of the consumer and to make changes and improvements as shall be in its opinion, necessary for the proper operation of the installation, at such times as may be mutually agreed upon.

12. *Inspection of Installation.*—The utility shall have the right at all times to make an examination of installation of lights, motors and other apparatus of the consumer and it may refuse to make connection or give service unless the installation is in proper condition to receive and to utilize the same. The consumer shall not make any changes in his installation which may harmfully affect the operation of the utility's apparatus without consent of the utility

13. *Continuity of Service.*—The consumer understands and agrees that service will be furnished from a single line and that service may be interrupted from time to time due to accidents or making of repairs. The utility will use reasonable diligence in furnishing an uninterrupted and regular supply of electrical energy.

14. *Urban Rules.*—Rules applying to the utility's service, except as hereinbefore modified, shall also apply to rural service.

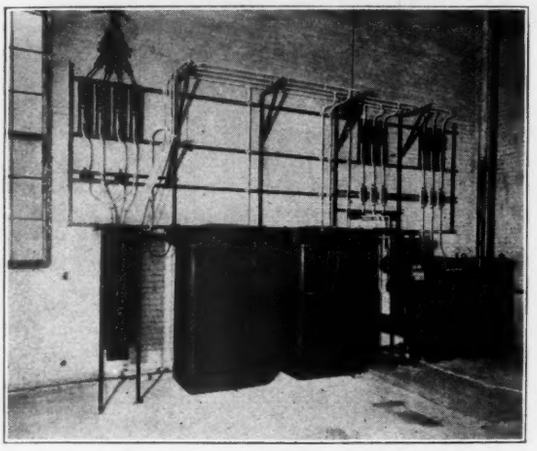
15. *Default.*—If the consumer defaults in any of his agreements herein contained, the utility may suspend service, such suspension not to interfere with enforcement by the utility of any legal right or remedy. No delay by the utility in enforcing any of its rights hereunder shall be deemed a waiver of such rights; nor shall a waiver by the utility of one of the consumer's defaults be deemed a waiver of any other or subsequent defaults.

MOTOR DRIVE IN A WASHINGTON FLOUR MILL.

Connected Load of 450 Hp., With Motors for Main Line and Individual Drives, Feature Electrical Installation in 1200-Bbl. Mill.

In the building of numerous flour mills in the Northwest, the provision for electric drive has become practically the accepted plan. In most localities such mills are within the zone of central-station lines, which relieves the mill companies of the expense of producing their own power. The recent equipment of a new mill at Everett, Wash., for motor drive, and connecting with central-station plants, may be referred to incidentally. This mill is owned and operated by the Portland Flour Mill Co., and has a rated capacity of 1200 bbl. of flour per 24 hours.

The motors installed represent a connected load of 450 hp. There is the main mill drive and a number of individual motors, some belt-connected and others direct-connected to the driven machines. One of the accompanying illustrations gives a view of the 250-hp., 2300-volt, three-phase motor, of the speed of 720 r.p.m., connected by rope transmission to the 300-r.p.m. line shaft, constituting the principal mill drive. The 10-part, 2-in. rope transmission has a length of about 30 ft. Leather belts are installed to transmit power from the main line



Transformers for Serving Electrical Equipment in Washington Flour Mill.

shaft to 14 wheat grinders and 7 sifters, the belt drives being nearly vertical.

Other machines are driven by 10 individual three-phase, 220-volt motors. The driven machines consist of bucket elevators, conveyors, vibrators and attrition mill. The latter, consisting of high-speed discs, is driven by two 20-hp. motors, direct-connected. The machine of greatest speed is a bar mill, driven at 3600 r.p.m. by a 25-hp. motor.

The other illustration shows, on the left, two standard 500-kw. transformers, used in this case for changing two-phase to three-phase energy required. The two 75-kva. transformers on the right, in the illustration, are used for stepping down the voltage from 2300 to 220 volts for the small individual motors. The secondary line that

250-Hp. Motor Connected for Rope Drive of Main Line Shaft in Flour Mill.

conducts the three-phase, 220-volt energy to the distributing panel in the mill is a 900,000-cir.-mil weatherproof cable.

The design for the electrical installation was made by Thompson & Castleton, Inc., Seattle, who supervised the work of installing.

Circuit-Breaker with High-Speed Characteristics

Protection of Direct-Current Generators from Flashovers and Short-Circuits Afforded by Breaker Operating at High Speed

By J. F. TRITLE
Engineering Department, General Electric Co.

The problem of protecting direct-current generators, particularly high-voltage generators, from flashover has received a great deal of attention in recent years. Various improvements have been made in the commutating characteristics of the machines, but as yet no commercial machine has been built which is immune from flashover under the most severe short-circuit conditions unless it is protected by some external device, such as a high-speed circuit-breaker.

Standard circuit-breakers operate much too slowly to prevent flashover on heavy short-circuits. Repeated tests have indicated that to prevent flashover a circuit-breaker should operate, stop the current rise, and reduce it below the flashing value in something less than the time required for a commutator bar to pass from one brushholder to the next. On a 60-cycle machine, this means a speed of approximately 0.008 sec. As the standard circuit-breaker operates in about 0.08 to 0.15 sec., it has less than one-tenth the required speed.

A new type of high-speed circuit-breaker has recently been developed which operates on entirely different principles from the original, particularly in regard to the method of tripping and the arrangement of the magnetic blowout. All mechanical latches and triggers have been entirely eliminated. The breaker is tripped electromagnetically instead of electromechanically. The spring power necessary to operate the device has been greatly reduced. The magnetic blowout has been improved and has a combination of two powerful magnetic fields and a narrow arc chute which increases the speed of blowout and reduces the arcing space required. The breaker is, therefore, very simple and rugged in construction and is much reduced in size, weight and cost.

One of these new type breakers is installed in series with each of the eight 3000-volt 2000-kw. motor-generator sets in the substations supplying power for the electrification of the Pacific Coast and Cascade Divisions of the Chicago, Milwaukee & St. Paul Railway. A similar breaker is also installed on each of the five new bi-polar gearless type passenger locomotives.

Fig. 1 shows a side view of this new type of breaker with the covers removed. Fig. 2 shows its principle features, together with the connections for installing it in the negative side of a generator.

In this latter illustration, *F1* and *F2* represent a laminated field structure something like that of an ordinary a-c. magnet. The poles of *F1* and *F2* are bridged by a very light armature *A* pivoted at *P* and held in contact with the poles by a shunt coil, *S1*, energized from any convenient constant voltage source such as the exciter circuit or the main bus. A series bucking bar, *S2*, which electromagnetically trips the

Fig. 1.—1500-Ampere 3000-Volt Direct-Current High-Speed Circuit-Breaker with Covers Removed.

breaker, is located between the poles of the field magnet and in close proximity to the armature. Thus the current flowing in the bar produces the maximum change in the armature flux with the minimum change in the flux interlinking the shunt winding, *S1*. The bucking bar simply shifts the flux from the armature to the air path at the right of the bucking bar, thus causing the armature to release as soon as its flux is reduced a predetermined amount.

The tension spring attached to the armature gives the high-speed opening of the contacts and also provides a means of adjusting the breaker. On account of the relatively light armature and the fact that it is not necessary to trip any latches to release the breaker, a pull of less than 800 lbs. is required of this spring for the 2500-

ampere capacity breaker, which is far less than that required in the original type.

The main contacts, *C1* and *C2*, are of the solid copper type used so successfully on railway contactors. Contact *C1* is materially heavier than *C2* and when the armature is released *C1* follows *C2* for a predetermined distance, but at a much lower rate of speed, so that *C1* and *C2* begin to part practically simultaneously with the beginning of movement of the armature.

The blowout coil *S* is in series with the main circuit and is designed to give a very intense field but of comparatively small area around the main contacts *C1* and *C2*. An additional blowout coil, *S2*, is provided in the auxiliary arc chute and is automatically cut into the circuit during the time the arc is being ruptured When the tips *C1* and *C2* begin to part, the series coil *S*, blows the arc upward off the tips onto the arcing horns *H1* and *H2*. As the arc moves further upward, it comes in contact with the ends of the arcing horns *H3* and *H4*, between which is connected the blowout coil *S2*. This inserts the coil in the circuit and divides the arc into

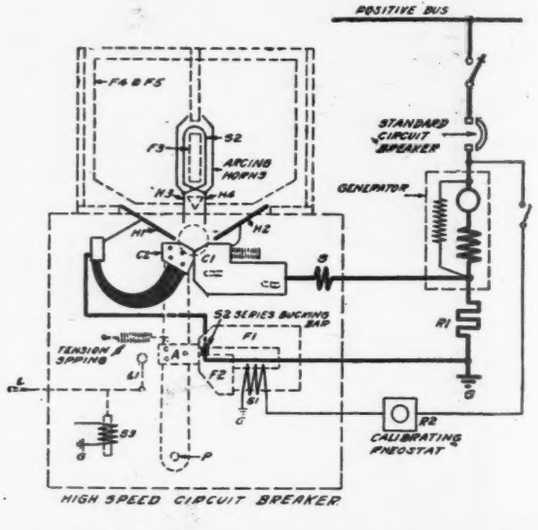


Fig. 2.—Schematic Diagram of the High-Speed Circuit-Breaker and Connections for Installation.

two parts, one of which is blown upward through the left-hand side of the chute between the arcing horns *H1* and *H3* and the other through the right-hand side of the chute between the arcing horns *H2* and *H4*. The coil *S2* surrounds the iron core *F3*, to which is connected the field pieces *F4* and *F5*, which cover practically the entire area of the auxiliary chute. The auxiliary arc chute is hinged at both ends so that it can be easily swung out of place for ready inspection of the main contact tips. The sides of the arc chute are also arranged in a novel way to provide an arc chute materially narrower than the contact tips, thus increasing the resistance of the arc stream for a given length and giving the maximum cooling effect to the vapors.

Means are provided for closing the contacts either manually by means of the handle *L* or remotely from the station switchboard through the solenoid *S3*, the plunger of which engages with the lever *L1*.

Fig. 3 shows a typical calibration curve for the high-speed breaker shown in Fig. 1. From this curve it will be noted that it requires a current of 0.17 amperes to hold the armature closed with zero current in the bucking bar. If it is desired to have the breaker trip at 2000 am-

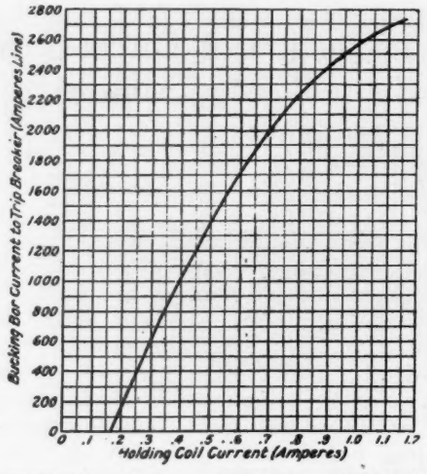


Fig. 3.—Calibration Curve for 1500-Ampere 3000-Volt High-Speed Circuit-Breaker.

peres load, it is merely necessary to adjust the holding current of *S1* to 0.7 amperes by means of the calibrating rheostat *R2*. The main current may rise to the trip value slowly, as in the case of overload, or rapidly, as in the case of short-circuit. In either case the armature of the breaker starts to move the instant its flux is reduced to normal drop-out value by the bucking bar current. On short-circuit, the current will rise to several times the normal tripping point and the flux in the armature will be reduced to a very small value or even reversed. This condition, however, gives the maximum speed of operation as the armature starts to move the instant the flux is reduced to normal drop-out value, and by the time the flux reaches zero, the armature is moving at a fairly high

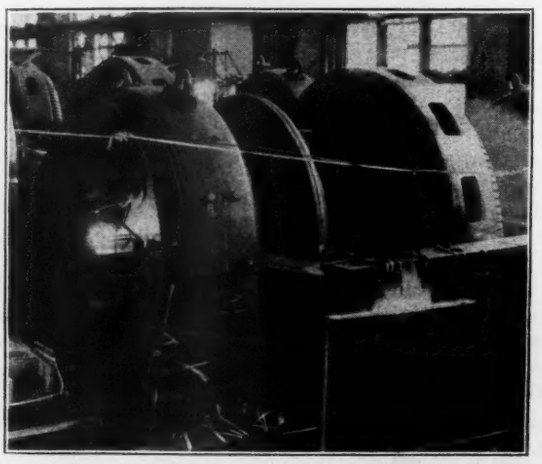


Fig. 4.—Short-Circuit on 2000-Kw. 3000-Volt Motor-Generator Set and High-Speed Circuit-Breaker.

rate of speed. On account of the high-speed and steep-pull characteristics of the armature, it is not possible for the bucking bar current to rise rapidly enough to build up sufficient reversed flux in the armature to hold it closed.

The connections shown in Fig. 2, with the

circuit-breaker installed on the negative side of the generator and operating to introduce a limiting resistance *R1*, gives the maximum protection against flashovers. With this connection any possible flashover current from the positive stud to frame has to pass through the limiting resistance to return to the armature. Tests have demonstrated that the breaker will successfully open the circuit completely instead of only inserting the limiting resistance, but it has been found in practice that better protection is afforded the machine if the current is ruptured in two steps.

Extensive tests under every conceivable operating condition were made on the breaker in connection with the Chicago, Milwaukee & St. Paul Railway motor-generator sets. The acceptance tests alone required approximately 65 successive short-circuits of various degrees of magnitude.

Fig. 4 shows the performance of one of the machines and the breaker during one of these tests. For these tests the positive terminal of the generator was connected to ground through a circuit-closing contactor and a high-speed circuit-breaker by means of a 1,000,000-cir. mil cable, the total resistance in the circuit, including that of the generator, being approximately 0.095 ohms. Five dead short-circuits were thrown on the set inside of 10 consecutive minutes at the conclusion of the acceptance tests without any flashovers. No attention was given the brushes or commutator during any of these tests.

Fig. 5 shows a dead short-circuit on a locomotive near the Erie substation. The high-speed breaker in the station was not in use and the short-circuit was easily cleared by the breaker and the line contractors on the locomotive. In Fig. 5, the voltage across the high-speed circuit breaker is shown by *A*, the line current by *B*, and the 60-cycle timing wave by *C*. Fig. 6 shows a dead short-circuit 9600 ft. from the substation.

The simplicity, ruggedness and reliability of this new type of breaker probably will open for it a wide field of application in the protection of d-c. apparatus. The magnetic blowout and arc chute are particularly effective and insure the successful rupture of practically any d-c. voltage which it is possible to obtain from modern commercial generators. In combination with the flash barriers this breaker insures practical immunity from flashovers under the most severe short circuit conditions. There are no latches, triggers, etc., to get out of adjustment; and, as the tripping mechanism is simply a straight copper conductor carrying the main current, the breaker may be expected to duplicate its performance many times in succession. It may also be used for the protection of feeders and other circuits as well as main generators.

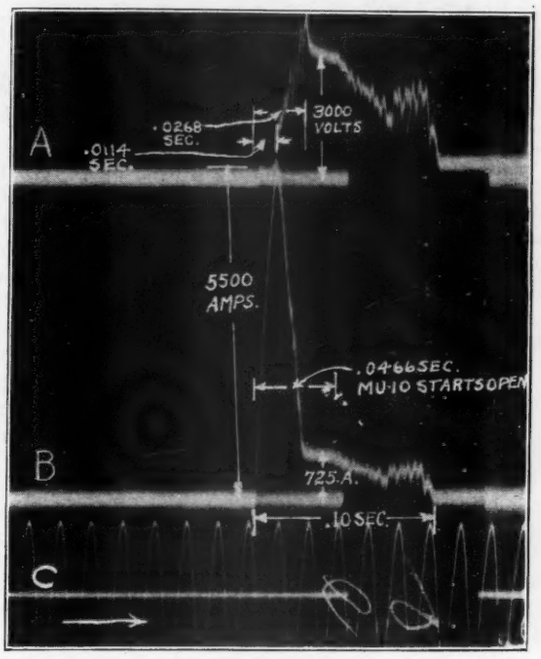


Fig. 5.—Short-Circuit on C., M. & St. P. Locomotive When Protected by High-Speed Circuit-Breaker on Locomotive Only.

One particular advantage of the protection afforded by this type of breaker is that it can be applied to old or new d-c. generators or synchronous converters of any type or voltage with no change whatever in the machine itself.

MICHIGAN COMPANY TO BUILD LINE.

The Consumers' Power Co., with headquarters at Jackson, Mich., will build a 140,000-volt transmission line, 70 miles in length, as part of its new development plan.

Fig. 6.—Short-Circuit 9600 Ft. from Substation on 1500-Kw. 3000-Volt Motor-Generator Set Protected by High-Speed Circuit-Breaker and Flash Barriers.

Elements in Valuation of Public Utility Properties

Factors to Be Considered by Commissions in Appraisements—Pre-War Basis Unjust—Influence of Intangible and Development Costs

By THOMAS E. PHIPPS

Formerly Chief Engineer, Public Service Commission of Washington.

The valuation of public utility property has only come into prominence during a comparatively recent period. A number of the states formerly had commissions exercising regulatory power over railroads, and from this beginning there has been a continual extension, both in the number of these commissions and their authority, until we now have in each of the several states at least one commission exercising regulatory powers over practically all of the several classes of properties engaged in rendering service to the public. This particularly applies to privately owned properties.

The case of *Smythe* vs. *Ames* in 1898 was the leading case holding, that, as a general rule, the test as to whether a rate schedule or regulation is illegal or confiscatory is whether it permits the company to earn a fair return upon the fair value of its property. The question of what elements or factors were to be considered by courts and commissions in the determination of fair value immediately arose. They seem to have all agreed that this value must be ascertained in some manner. With our system of law, wherein courts follow precedent whenever satisfactory precedent is to be found, the development of the rule laid down in this leading case has been quite slow and has resulted in numerous conflicting decisions being rendered.

Decisions of the court must of necessity be based upon the evidence submitted and upon the presumption, of course, that all facts pertaining to the case have been included. Now, it is probable, and it is contended, that all the facts were not presented in many of these cases and, furthermore, that facts that were presented were not clearly elucidated. This is an indictment resting upon the engineers themselves and they must assume the responsibility for a good portion of the confusion resulting from the conflicting decisions.

Factors in Determining Valuation.

Not only must all the factors entering into the determination of value be considered, but it seems that to a great extent the purpose for which the valuation is made is of prime importance.

Valuations are usually made for the purposes of rate regulation, purchase and sale, taxation, capitalization; and may also be made for the purposes of negotiation of loans, and securing of additional vested rights.

The first four purposes enumerated are those for which official valuations of the property of public service utilities are made, and due to the activities of commissions attention is most frequently called to the first of the four—that of valuations for rate regulation.

The Washington Public Service Act, laws of 1911, Chapter 117, Section 94, provides for the procedure in the valuation of property by the commission of this state and enumerates among other things those elements which were considered by the framers of the act as essential in the determination of value. It further provides that these elements shall be ascertained as early as practicable of the property of every public utility in the state.

Among the first of these is what has come to be commonly termed "cost of property" and which is usually referred to in commission acts as the "cost of construction and equipment."

It has been assumed that what was desired was a thorough investigation of the accounting records of the company, or companies, owning and operating the property from its inception and the compilation in accordance with present approved accounting classification of the costs incurred in constructing and equipping the plant, together with the intangible expense, insofar as found of record.

Records Not Always Complete.

It will readily be seen that in the case of plants which have experienced changes in ownership, or have resulted from consolidation or even partition, that accounting records might not always be available. Not only that, but in this part of the country, with its later development, almost all of the utilities now operating were initiated and in operation long before the present prescribed system of accounting. This necessitates a knowledge of the present system, as well as an acquaintance with the physical plant in order that the expenditures recorded in the different systems formerly used may be properly distributed in conformity with present standards. Where such records are available it is possible to find the actual cost of the property. It is quite usual to find such records missing and the information absolutely unavailable.

"Present cost of construction" has been enumerated as a factor to be found and considered, and to meet this requirement is one of the reasons for making an estimate termed the cost of production. Where cost of property is unavailable from accounting records, cost of reproduction has been of particular value in that it reflects within reasonable limits the actual cost of the property. This is particularly true where the prices applied in arriving at costs of material and labor have been determined historically or from actual performance with reference to the con-

struction of the property being considered. It has been customary to find weighted average prices, say of a 5-year period immediately preceding the date of the appraisal.

During an extended period, prior to 1914, and for a sufficient length of time to cover the life of many of our properties, there has not been such marked variations in the prices of material and labor and in labor conditions, but that costs based upon a 5-year period would not closely approximate the actual costs incurred, and found upon the accounting records where such records were available. This period, now termed the pre-war period, and the smaller range in prices have resulted during the past 5 years in the fallacy of continuing to use averages taken from the pre-war period and terming them "normal prices." As a matter of fact there is no such a thing and the term is a misnomer. It was probably based upon an assumption that the costs of material and labor would shortly revert to those prevailing prior to the war.

Pre-War Cost Basis Unjust.

Our own nation, and most of the other nations, in the past five years have enormously inflated their currency, and a purchasing power permitting the reversion to former conditions with regard to costs is in the remote future, even if it is ever again to be experienced. There is no present condition that shows any tendency other than to continue at the present high level, and we are logically bound to expect future material and labor costs and conditions to parallel those of the present rather than of the pre-war period. Consequently, a cost of reproduction based upon prices of a pre-war period can only be used for one purpose and that is to supplement the cost of property or to reflect it where accounting records are not available. As for showing the cost of reproduction new, such a result would be unfair in that it would be misleading and far short of the result that should properly be shown.

Cost of reproduction is usually made the basis for the computation of the depreciation allowance to cover renewals and replacements. The fact should never be lost sight of that the costs of material, labor and equipment necessary to provide such renewals and replacements are always present-day costs and not costs which may have prevailed at some time in the past. Furthermore, the cost of reproduction, less accrued depreciation, which is presumed to meet the requirement to find the "cost of the property in its present condition," is quite materially affected. Other than reflecting a condition of plant indicating the ability to render efficient service, this result is a rather questionable factor in the determination of value for rate-making purposes, but it is of prime importance as a factor in the determination of value in a case of purchase and sale.

It might be well to call attention to the fact that cost of property, cost of reproduction and cost of reproduction less accrued depreciation all represent cost, and that while they are factors in the determination of value neither of them is value, nor should be taken as value regardless of the fact that in many cases of courts and commissions such a fallacy has been indulged.

It seems that almost every one of the several commissions throughout the country have in the past been following the erroneous practice of finding cost of reproduction, less accrued depreciation, as value. While much mischief and loss has resulted from such procedure, the same bodies are in the main seeing the light and summoning the courage to repudiate these earlier blunders, and no longer tend to indulge in such misleading findings of value in rate cases.

Intangible Costs.

They have also quite generally come to recognize that there are certain costs incurred in connection with every undertaking which are not represented by physical property but which are equally as much a part of the actual cost and should properly be included in cost of reproduction as an element for determining value. These have been termed overhead costs, or intangible property. Among these are promotion, organization and legal, engineering and superintendence, general expense, taxes during construction, interest during construction and underwriters' and brokers' fees.

Promotion cost is incurred in the pioneering service rendered by some party or parties in the development of every project, and proper compensation for the business sagacity, forethought and vision of future responsibility on the part of a capable promoter is in all justice a fair expenditure to be incurred.

There results a definite organization, the functioning of which results in other expenses being incurred during the actual construction and until such time as the completed plant is ready for business. Executive and legal expense constitute the greater portion of this organization cost.

Engineering and interest and taxes during construction are surely terms so well recognized as to need no explanation.

Underwriters' and brokers' fees represent those costs which are incurred through the paying of reputable brokers for making investigations of the enterprise and inducing investors to purchase the securities which are issued. Bond discount, in many cases, is a part of the fee allowed for underwriting the securities and making the financing of the project possible. This represents a cost that must be incurred, even though attempted by the utility's own organization. The fact that it is usually handled by outside parties, who by reason of their organization for such activities can do it at a less cost, is to the credit of the utility organization.

There seems never to have been much question as to whether these intangibles should be considered as proper costs for which the utilities should be reimbursed. The problem seemed rather to have been whether it should be through amortization by excess earnings during earlier years or by capitalizing and permitting an earning thereon. In few cases has it been found that there was reimbursement through amortization by earnings, and capitalization seemed to be the only way out. This seems a fair manner to dispose of the problem in rate cases and cases of bargain and sale.

Keeping in mind that these intangibles, with the possible exception of engineering, would in

the main be charged to operating expenses after the property begins operation; that they are not represented by physical property, and the reason for and manner of their being included in property, it must readily be seen why it is contended that they should be excluded from consideration as elements of value in cases of taxation.

These overhead costs are quite generally stated as percentages of the cost of the actual physical plant, since their percentage relation for different classes of properties is known within reasonable ranges, and for the further reason that it is much more readily applied under this method.

Working Capital a Factor.

Working capital in rate cases must be included as a factor. A sufficient fund must be provided from capital for the purchase of materials and supplies, payments of employes and the other expenses of rendering service to consumers in advance of payment for such service. This may be considered a revolving fund reimbursed from time to time from operating revenue, but it must always be available for that particular purpose. It has become common practice to allow not less than one month's expenses to utilities which bill for service in advance, and not less than two months' operating expense to utilities billing subsequent to rendering the service. In case of purchase and sale working capital is not a factor.

The term "unearned increment" is quite often used in regard to land value. Under no circumstances should less than the actual cost be used for lands actually necessary for operation and reasonable extension, especially in rate cases. This should be available as a matter of record in most cases.

Finding of Land Valuation.

The sales method, which consists of the study of transfers of neighboring property having conditions and characteristics similar to land in question, is most commonly used in finding land values. While it is common knowledge that lands purchased for utility purposes are as a rule only acquired at a hold-up cost in excess of similar acreage of adjacent or contiguous lands, the courts have persistently ruled that no utility factor shall be used to represent such an increase in cost for utility use. Owners of such acreage, it is equally as generally held, are entitled to consequential damages due to the manner in which the land is usually taken. Then surely the land taken must also have a value because of the manner in which it is connected up—say in case of pole line right-of-way—over and above that of adjacent acreage of which it may formerly have been a part. As yet, however, the use of a utility factor has been denied in rate cases and it is only in cases where there has been a marked increase in value of contiguous lands that any increase, or so-called unearned increment, has been allowed. The utility itself may have been the agent actually creating the increase in value of such contiguous lands.

Factor of Development Cost.

Among the factors which have been the source of many and varied rulings are going value and going concern value. If going value had been properly named and called development cost, a good part of the confusion which has resulted because of the similarity of the terms would have been avoided.

Going value, more properly termed development cost, may be defined as the cost incurred in placing the property on a self-supporting basis, and is based upon the losses of the earlier years of operation and is in reality the uncompensated cost incurred in developing the business. If the history of the property shows from a study of the earnings and expenses that the loss of this earlier period has been recovered by excessive income in subsequent years, thus amortizing this cost, then this factor is eliminated, otherwise it must receive further consideration and, like the intangibles, may be capitalized.

Going Concern Value.

Going concern value is the element of value added to the value of the bare physical plant on account of its being a successful and harmoniously operating plant, co-ordinating in its various parts, or more briefly and pointedly, the difference between the physical structure completed and ready to operate, and the same plant successfully operating—the difference between a dead and a live plant. While this has been quite generally excluded from being considered as an element of value in rate cases it is of prime importance in cases of purchase and sale. Some of our worthy servants might well consider this point prior to the incurring of expense in regard to a recent purchase. It might easily exceed any depreciation allowance that could be determined.

As recently as Jan. 7, arguments were presented before the Interstate Commerce Commission upon the question of final value which should be found for the railroads of the country. Up to the present time no final figure for the value of any railroad has been found by this commission. Judge Prouty, chief of the Division of Valuation, expressed the view that the final value of a railroad should be the cost of reproduction, less depreciation, plus appreciation and going concern value. This is the first time that it has been officially suggested that allowance be made for going concern value. Bearing in mind that these values are for rate making and regulatory purposes, this contention by Judge Prouty is quite interesting. He evidently is willing to concede that energy, effort and more than average intelligence engaged to conceive, construct and manage utilities privately owned and dedicated to the public should receive compensation in addition to that received on the actual cash investment. This is in accord with a recent United States supreme court decision that going concern value is a property right upon which the owner is entitled to earn a fair return and must, therefore, be considered in determining a value for rate making purposes.

Recent Supreme Court Decision.

Now, while Judge Prouty only recommended an inclusion of 7 or 8% of the cost of reproduction to cover this element, the really important point is that this element was to be included. It will be observed, however, that he is still clinging to the old fallacy of desiring to make a deduction from plant value for depreciation. Nothing has been gained in the final result by a going concern allowance limited to 7 or 8% if a 20 or 25%

deduction is to be made for depreciation. The learned judge has surely overlooked the established principles which have been leading the various regulatory bodies to desist from continuing to indulge in this blunder: (1) That a utility property dedicated to the public use is entitled to earn operating expenses, including taxes, and in addition thereto, an amount sufficient to pay a return on the investment and provide for the renewal and replacement of the property during its life time; (2) that because of the powers of regulatory bodies accepted as rightfully granted, this fund to meet renewal and replacement is subject to being called into use by these bodies to insure continuity of service, and whether provided from the funds earned and set aside for renewals and replacements, or from assessments against the owners where these funds have been dissipated or even unearned; (3) that no increase in the plant account, on which earnings are based, is permitted because of expenditure for such renewals and replacements.

If such a deduction were to be made because of renewals or replacements not being required for a plant whose life had expired, and the depreciation fund to cover the renewals and replacement of such property was disbursed to the owners, such a disbursement could not be considered as a distribution of earned profits, but merely a return of original capital.

There are a number of other elements which might be enumerated, some of which are necessary in the determination of value, but it was the purpose of this paper to discuss only those which alone are so often mistaken as representing value, while as a matter of fact they represent cost instead.

By way of summary, it is desired to call attention to the necessity of first considering the purpose for which the valuation is to be made before attempting to determine those elements which are really factors. In no case should cost be mistaken for value. Engineers should always be mindful of the fact that courts and commissions are dependent upon them for the principal elements necessary in the intelligent determination of value in all cases, and earnest and honest effort should be made to set out all facts clearly and fully, else decisions are bound to follow which will result in serious injury to the credit of the utilities involved. And further, that since these utilities are not only the pioneers, but the leading agents in the continued development of communities, injury to the public served must also follow.

FIRST YACHT TO BE ELECTRICALLY PROPELLED.

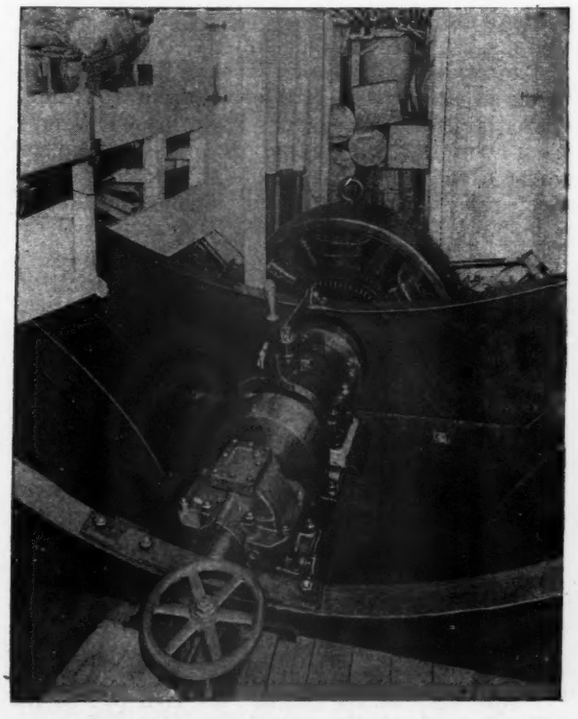
Auxiliary Oil-Electric Propelling Apparatus Installed on Yacht "Elfay" Proves Success of Such Equipment.

The first yacht to be driven by the Diesel electric system of propulsion is the "Elfay," which was recently fitted up with such equipment. The vessel was built by Herreshoff in 1914 and is essentially a sailing schooner, 152 ft. over all, 30-ft. beam and 313 tons gross. Her present owner, Russell A. Alger, Jr., desiring to have

Motor Propeller Controller Mounted on Deck of Oil-Electric Propelled Yacht "Elfay."

auxiliary propelling apparatus, installed a six-cylinder 115-hp. Winton-Diesel oil engine direct-connected to a 75-kw. Westinghouse generator, which supplies power to a 90-hp., 360-r.p.m. motor direct-connected to the propeller.

The control of this motor is centered in a single handle located on the deck. By turning the handle in one direction the propeller motor is started from rest and brought through several steps up to full speed ahead. By turning the



Driving Motor on the "Elfay," Connected to Propeller by Means of a Clutch.

control handle in the reverse direction the motor is reversed in a similar manner. The change from full speed ahead to full speed astern can be effected in 5 seconds. It is not necessary to signal to the engine room, the officer in charge having full control of the propelling equipment. A set of meters gives the navigator full information as to the performance of the machinery.

This simplicity of control is due to the fact that the controller regulates neither the main engine nor the main motor current, but only the small generator field current. The engine itself is operated from the engine room but is merely kept going at normal speed in one direction only.

All of the auxiliary equipment of the "Elfay" is electrically operated, including the winches, pumps, fans, blowers, ice machines, etc. She is also electrically heated.

The "Elfay" will depend mainly on her sails, but she has a cruising radius of 2000 miles on her motor drive, since she can carry 2400 gals. of fuel oil and consumes 7.5 gals. per hour. Her speed at the full power of the motor is 8.5 knots.

CLEVELAND ROTARY CLUB IS HOST AT ELECTRICAL LUNCHEON.

James M. Wakeman, of Society for Electrical Development, Tells Objects of Organization at Cleveland Meeting.

The regular weekly luncheon of the Rotary Club of Cleveland, O., March 18, was made an electrical luncheon on account of the great interest in the Cleveland Electrical Show, which was in progress at the time. James M. Wakeman, general manager of the Society for Electrical Development, was the principal speaker, and said in part:

"The growth of the electrical industry is remarkable not alone for its rapidity and immensity but also because it has been accomplished through the active unselfish co-operation of the various branches of the industry.

"Naturally, as in other businesses, there are trade organizations, but, in addition to those, there is this Society for Electrical Development working in a co-operative spirit in the interest of all, and that word 'all' includes those electrical companies and individuals who do not contribute to the support of the organization in any way.

"Personally, I am frequently impressed by the manner in which people visiting an electrical show, such as you have now running in Cleveland, accept all the truly marvelous devices shown. They appear to regard them without any appreciation of the patient engineering and inventive work that is necessary to produce them. They evidently do not realize the immense amount of money invested in power plants, transmission lines and apparatus, the complicated big machine and the delicate little device that have to be designed, built and used to bring to the table or the kitchen, to the bedroom or the laundry, the servant that responds instantly at any hour of the day or night at the touch of the button!

"And back of the button! the coal pile or the waterfall, the boilers or the turbines, the generators, the transformers, the miles of transmission lines either underground or overhead; the copper, the iron, brass, steel, rubber, mica, carbon, platinum, brought from far off corners of the world, put together with ingenuity and skill, established in a community for service; and through the steady work of men, an army of men, from brainy engineers to brawny coal passers, people just press a button and evoke the genii to whom they indicate whatever task they wish performed and issue the command 'do it electrically.'

"As to the uses and importance of electric power in carrying on the industrial life of the country, the society has compiled a list of over 3000 uses for electricity, classified by trades from aerial swings to wood-working establishments.

"The progressive men in the electrical industry gifted with broad vision, organized the Society for Electrical Development to teach people the uses of electricity, to lead them to appreciate its value to the community, to realize what is necessary to place this tireless servant at their command. The enormous growth of the industry has more than justified the optimistic foresight of the men who organized the society."

Mr. Wakeman closed his address by pointing out the necessity for speeding up factory production in order to meet the world-wide competition of European manufacturers. He said the one great factor in speeding up the production of this country is the industrial electric motor.

Miss Grace T. Hadley, the electric household specialist of the Society for Electrical Development was in daily attendance during the show, explaining the uses of household appliances and addressed two women's clubs in Cleveland.

UNITED ELECTRIC LIGHT & POWER HAS 65,000 N. Y. CUSTOMERS.

In an article in the March 20 issue of the ELECTRICAL REVIEW telling of the 40 years of service of Frank W. Smith with the United Electric Light & Power Co., of New York City, the statement was made that the company serves 40,000 customers in the Borough of Manhattan. As a matter of fact the correct figure is 65,000 customers; in addition the company operates the western terminal of the New York, New Haven & Hartford Railroad Co.'s electrified system and also supplies high-tension service for distribution by local companies to the Borough of the Bronx, a large part of Westchester county and the Borough of Queens. Mr. Smith is now third vice-president of the National Electric Light Association, having held the office of treasurer during the preceding year.

MISSOURI ASSOCIATION WILL HOLD CONVENTION IN JUNE.

The Missouri Association of Public Utilities, representing practically all of the public utility companies in the state, will hold its fourteenth annual convention at Jefferson City, Mo., June 2-5, inclusive. The convention program and list of speakers will be announced later. F. D. Beardslee, 315 North 12th street, St. Louis, Mo. is secretary of the association.

EDITORIAL COMMENT

Progress in Revising the Code

If evidence had been needed to show that the new procedure in revision of the National Electrical Code adopted by the Electrical Committee of the National Fire Protection Association was a step in the right direction it was certainly furnished by the smoothness with which the public hearing on Code revision was conducted in New York City last week. Many of the similar meetings held in connection with previous revisions were largely drawn-out wrangles and it will be remember that the last one, in 1917, was long tied up by litigation. It was a pleasant contrast, therefore, to find that the numerous standing committees and technical subcommittees had during the past year received a mass of suggestions, and, after carefully considering their necessity and probable effects, had been able to make deliberate specific recommendations in their published reports. Consequently, the public hearing had as its working basis some dozen well-digested reports of the principal standing committees instead of a heterogeneous multitude of original suggestions to which but little consideration could be given.

It was not to be expected that the Electrical Committee at its formal meeting subsequent to the public hearing would adopt all of the recommendations of its subcommittees, because, in the first place, the larger body is naturally a more conservative organization than its subdivisions, and, secondly, because there were bound to be some conflicts between the recommendations of the subcommittees. A pleasant surprise was in store, however, to find the action of the main body made public so promptly. An abstract of this action came to hand just in time to be published in this issue. It shows that the great bulk of the recommendations by the standing committees were adopted substantially as reported by them and that the departures therefrom were as a rule minor in character. As stated above, the Electrical Committee as a whole is not ready to go as far nor as fast as its standing subcommittees, some of the opinions of which are evidently looked upon as radical by the other members.

The main thing worthy of note is that the new procedure is manifestly progressive. It brings about more thorough considerations of suggested changes and accurates their adoption if worthy. It has quite promptly made public the final action on the various recommendations. It is to be hoped that it will also result in more careful editing of the new edition of the Code and, if possible, accelerate its issuance so that the electrical industry will not have to wait a period of eight or even six months for the printed copies of the 1920 edition.

Electric Service for the Farmer

Much attention is being given to the extension of central-station lines to serve urban customers. It is a timely subject. There are two outstanding reasons which may be ascribed to the present-day activities in this direction. One is that the demand of the farmers for electric service is quite urgent and that they are willing to pay any amount within reason for such service. The other is that central-station companies are coming to realize that their distribution systems will eventually be extended to more thoroughly cover farming territory and small municipalities in their different localities and that this development should not be hindered, if possible.

The growth of electric service for urban communities resembles closely that experienced with telephone service some years ago. Both have the same underlying motives. The telephone was recognized by farmers two decades ago as a device of utility and convenience, and this recognition was followed by a surprisingly large number of installations of farm telephone lines. At present, the farmer is beginning to fully realize the utility and convenience of electrical devices and the natural conclusion is that during succeeding years there will be corresponding activity in means to obtain electric service. The utilitarian electrical devices that compensate in no little measure for the scarcity of farm labor, taken together with electric lamps and other devices that afford greater convenience in urban life, have, when realized, made the demand for electric service by the farmer insistent, especially at the present time, when his evident prosperity makes the acquirement possible.

That the electrical industry will meet this demand, just as it has satisfied the demands for lighting, power and transportation facilities, seems certain. The urgency of it will be the deciding factor.

Outside of individual electric plants for farm service, first consideration of supplying electric

service comes to the central-station companies. Records show that quite a number of companies were serving urban customers eight or ten years ago, these instances being where special demands for service were present and where the extension of lines was not a difficult undertaking. The experience of these central-station companies has been satisfactory in some cases and in others serious objections have been encountered as to the amount of investment and income derived, and other considerations making the supply of such service undesirable. These objections have made numerous central-station companies chary of entering the field, especially in view of latent opportunities for business within the confines of their existing distribution systems, of difficulties in securing capital for extensions and, in some cases, of lack of surplus station generating capacity.

But the increasing demand by the farmer, coupled with the fact that broadening the field of urban service offers an exceptionally potential field for the sale of electrical devices, has resulted in major consideration of the subject. This is evidenced by the recent report of the Committee on Rural Extensions of the Wisconsin Electrical Association, which gives the results of investigations made in regard to installation and operation of a number of farm lines in that state. This report, which is printed on other pages of this issue, shows, while intimating the necessity of supplying the demands for farm service, the wisdom of taking on and handling such service in such manner and under such restrictions that it proves profitable to the central-station companies. Rules have been drafted so this end may be accomplished.

The crux of the situation is for the central stations to meet the demands for electric service on the farm, but to take such precautions as to make it desirable from every standpoint.

Central Stations and Daylight Saving

Adoption of the daylight-saving plan by many municipalities throughout the country will undoubtedly cause substantial losses in revenue to numerous central-station companies.

The movement is receiving quite an impetus Middle western cities like Cleveland, Detroit. Cincinnati, Minneapolis and a large number of smaller cities in Michigan, Ohio, Indiana, Illinois and other states have already adopted the plan. Denver and a number of cities in that vicinity have done likewise. In the eastern section of the country sentiment is divided. An attempt to repeal the daylight-saving ordinance failed in New York state this week, while New Jersey and Massachusetts now have such an ordinance pending before their legislatures, with the likelihood of approval in both instances. Local daylight saving is now effective in Hartford Conn., and is being taken up by other Connecticut towns. Worcester, Lynn, Clinton and Marlboro, all Massachusetts towns, have adopted the plan.

It is not at all opportune for the central-station companies. Just now they need revenue to apply on line extensions and new equipment to take care of the increasing demand for capacity. Shortening the evening load results in idle generating equipment, with attendant investment charges, and, tersely, shortens the central station's working day. And the more the plant capacity installed the greater will be the loss in net revenue.

But despite the objections to daylight saving from a central-station point of view, the forbearance which has been shown in this connection is noticeable. Most of the expressions of objection have come from those who have been inconvenienced—a matter of changing habits or something of that sort. Wide acceptance of the plan is of more vital moment to the central-station companies; there is no recourse from the revenue lost. But with fine regard for whatever the public considers its good, there has been no "holler" from the central-station men.

Geographic Sections of the N. E. L. A.

Reorganization plans of the National Electric Light Association are rapidly assuming definite shape and will be ready for presentation in detail at the annual convention of the association at Pasadena, Cal., May 18-22.

Probably no part of the reorganization plans has attracted as much attention as the work of establishing thirteen geographic sections within the national association. Enough preliminary work on this plan has been done to assure that the necessary support to obtain its adoption will be given at the national convention.

The geographic section plan seems to be a broad step in the right direction. When properly functioning, the sections will arouse more interest in the workings of the national association. The very plan of organization of the sections assures this, since a larger number of representatives of central-station companies will be working on problems that confront the electrical industry, particularly the central-station phases of it, and it is a natural consequence that the more persons an organization can interest in its workings the more successful it becomes, particularly if this interest and work is directed into channels that do not conflict with one another.

CURRENT EVENTS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

MERGER OF ENGINEERING AND CONSTRUCTION COMPANIES.

Westinghouse Church Kerr & Co. and Dwight P. Robinson & Co. Are Merged Into One Concern.

Of general interest is the combination recently announced of the organizations of the Westinghouse Church Kerr & Co., Inc., engineers and constructors, New York City, and Dwight P. Robinson & Co., Inc., constructing and consulting engineers of New York City. The new company will be called the Dwight P. Robinson & Co., Inc., and will occupy executive offices at 61 Broadway and engineering and designing offices in the Grand Central Palace, 125 East 46th street, New York City.

Dwight P. Robinson, president of the new company, was for many years president of the Stone & Webster Engineering Corp. and formed his own company in 1918. He has had an unusually valuable experience in the design and construction of industrial plants, large central power stations and hydroelectric plants, and his company has specialized in work of this nature. At the time of the merger the Robinson company had large power plants under construction for the Duquesne Light Co., the Penn Public Service Co., and others.

Westinghouse Church Kerr & Co., Inc., established 36 years ago, has specialized in the design and construction of industrial plants of all kinds, railroad shops and terminals and industrial power plants. As the activities of the two companies were largely supplemental, each making its own specialized contribution to the new company, it is believed the new organization will become one of the largest and most successful in the construction and engineering business.

PACIFIC COAST SECTION, N. E. L. A. HAS LONG PROGRAM.

Varied Subjects to Be Presented in Papers and Addresses at Annual Convention to Be Held at Pasadena.

The Pacific Coast Section of the National Electric Light Association will hold its annual convention at Pasadena, Cal., May 17 and 18, preceding the sessions of the national association. All the sessions will be joint meetings of the various sections, the program of papers being as follows:

Commercial Committee—"How the Electrical Industry Should Co-operate with the Architect and Builder," by Garnett Young; "The Value of Proper Illumination," by F. D. Fagan; "Commercial Aspects of Railway Electrification," by E. B. Criddle, W. L. Frost and G. B. Kirken; "Commercial Aspects of Storage of Water at High Elevations," by E. B. Walthal, D. R. Kenney and E. J. Crawford; "Central-Station Power vs. Internal-Combustion Engines," by R. E. Fisher; "Standardization of Wiring Devices, Terminals and Budgets," by H. H. Courtright; "Electrical Development of Oil Lands," by R. A. Balzari; "Value of Solicitors," by A. W. Childs, and "Statistics Regarding Unelectrified Horsepower," by J. O. Case.

Engineering Committee—"Railway Electrification," by J. E. Woodbridge; "Method of Improving Power-Factor and Suitable Rates," by E. A. Quinn; "Use of Maximum Rated Motors as Affecting Central Stations and Consumers," by John Hood; "Electric Furnaces," by J. A. Koontz and W. M. Shepard; "Economic Use of Galvanized Steel Wire," by J. P. Jollyman and J. F. Strachan; "Progress Reports on Insulator Investigations," by J. A. Koontz; "Relay Protective Systems," by G. E. Armstrong;" "Automatic Protection of Small Motors," by G. E. Armstrong; "Use of Variable-Speed, Alternating-Current Motors vs. Direct-Current Motors for Elevator Service," by S. J. Lisberger.

The Accounting Committee will have two papers, one on "Construction Accounting," by C. P. Staal, and the other on "Standardization of Titles," by A. B. Carpenter and R. R. Reidford. The Publicity Committee will have a report on activities, by L. W. Alexander. In addition to the above papers a special report on the California Electrical Co-operative Co. will be made by L. H. Newbert.

ASSOCIATION HEADS APPROVE N. E. L. A. GEOGRAPHIC PLAN.

Representatives of Michigan, Indiana, Illinois and Wisconsin Electric Light Associations Favor New Plan After Conference.

Approval of the new geographic section plan of the National Electric Light Association was given by presidents and secretaries of the Michigan Section of the N. E. L. A., Indiana Electric Light Association, Illinois State Electric Association and Wisconsin Electrical Association at a conference held in the Commonwealth Edison building, Chicago, March 26.

The conference was arranged by M. H. Aylesworth, executive manager of the N. E. L. A., and was attended by W. C. Lounsbury, president, and J. P. Pulliam, secretary of the Wisconsin association; P. H. Palmer, president, and Thomas Donahue, secretary of the Indiana association; W. M. Lewis, president, and Herbert Silvester, secretary of the Michigan Section, and B. J. Denman, president, and R. V. Prather, secretary of the Illinois association.

Mr. Aylesworth illustrated his talk about the

new plan with the aid of a large chart showing the connection between the various sections and groups involved, the chart tracing the course of the organization from the state associations to the president and executive of the N. E. L. A.

In opening his talk Mr. Aylesworth made it clear that the national association does not desire to absorb nor has it any intention of absorbing the various state associations, but it proposes to give them more functions to perform in connection with and under the direction of the Geographical Section organization to which they belong.

Under the plan Michigan, Indiana, Illinois and Wisconsin will constitute one of the 13 Geographical Sections that will be formed within the N. E. L. A. The Michigan and Wisconsin associations are now Geographic Sections of the national organization; the other two states are not.

Briefly outlined, the plan is for each of the state organizations in the United States to name from its members delegates or members to represent it in the Geographical Section to which it belongs. These delegates or members, no special designation having yet been chosen for them, will then meet in conference and select a chairman or president and that officer will become a member of the Executive Committee of the N. E. L. A.

The chairman of each Geographic Section will, as a member of the National Executive Committee, be informed on what activities are contemplated by the national body and will transmit all of them to his section, leaving it to the wishes of that body to take up and become active in the promotion of such subjects as fits its needs or that of the industry in the community in which it serves.

It was explained by Mr. Aylesworth that it was not the intention of the Geographic Sections to take over any of the functions of the state associations in regard to handling purely state affairs. State associations would still handle matters of legislation and matters in connection with public utility commissions of their own state, the Geographic Section being interested only where the matter or question involved was one of a nation-wide interest or one concerning the policy of the N. E. L. A.

In answer to questions of President Palmer of the Indiana association and President Lewis of the Michigan Section, Mr. Aylesworth made it clear that the formation of Geographic Sections would not result in any increase in expense for the state associations forming the different groups. It was the intention of the national association, Mr. Aylesworth said, to refund upon a budget approved by the Executive Committee certain expenses of the Geographical Sections, while the state associations would handle their own financial affairs as in the past.

In closing the conference Mr. Aylesworth asked the executives of the state associations to present their views on the plan as outlined and it was given unanimous by those present. Secretary Pulliam of the Wisconsin Electrical Association stated that that association had gone on record as favoring the plan and Michigan likewise is on record. The representatives of the Indiana and Illinois associations said they would have to take the matter up with their executive committees before taking action. On motion of president Lounsbury of the Wisconsin association, seconded by President Palmer of the Indiana association, the following resolution was adopted: "Resolved, that it be the consensus of opinion of the representatives present that the plan for reorganization of the National Electric Light Association, including Geographical Sections, is essentially correct and that we unanimously agree to recommend to the executive committees of the state associations represented here full co-operation in the plan."

Mr. Aylesworth said during the session that enough states had already accepted the Geographical Section plan to make sure that the necessary action to put it into effect would be taken at the N. E. L. A. convention in Pasadena, Cal., May 18-22 next.

A thorough explanation of the plan, including chart showing make-up of the organization, will be sent to all N. E. L. A. members from the New York City headquarters in the near future. In addition to this, Mr. Aylesworth will prepare for an early issue of the ELECTRICAL REVIEW an analysis of what the Geographic Sections really mean to the industry. The National Executive Committee will pass upon the reorganization plans of the national association at its meeting to be held in New York City on April 8, thus preparing the way for final action at the Pasadena convention in May.

CLEVELAND ELECTRICAL SHOW HAD OVER 150,000 VISITORS.

The Cleveland Electrical Show, held from March 10 to March 20, under the management of the Electrical League of Cleveland, proved a far greater success than anticipated by the most optimistic of its promoters. For 10 days exhibitors were continually busy demonstrating their wares to interested spectators who wanted demonstrations because they wanted to buy. Curiosity seekers were far in the minority among visitors to the Cleveland show. An average daily attendance of more than 15,000 was recorded. On one day, when special attraction was provided, including the public marriage of a couple for whom an electrical "hope chest" had been contributed by exhibitors, more than 20,000 admissions were received. The total attendance was over 150,000. The electrical "hope chest" included an electrical range, washing machine, vacuum cleaner, lamps, toaster, percolator and all other electrical devices necessary for the electrical equipment of a modern home.

That people are ready for complete electrical equipment of home was demonstrated by the purchases made and orders given by visitors to the show. At the close of the third day of the show orders totalling more than $1,000,000 had been booked by exhibitors.

The success of the Cleveland show is a tribute to the home management of affairs of this kind in which local merchants and manufacturers are chiefly interested. Instead of turning over the management of the electrical show to a professional promoter, the Electrical League of Cleveland took it in charge and made various members and committees responsible for its success.

Results were decidedly beneficial to the league as an organization and to the exhibitors who participated. The favorable reception of the show by the public is largely due to the efficient management of the executive committee headed by G. S. Miller, general manager of the Erner Electric Co., and the publicity committee headed by P. B. Zimmerman, advertising manager of National Lamp Works, Nela Park.

JANUARY ELECTRICAL EXPORTS MAINTAIN AVERAGE.

Exports of electrical goods to foreign countries in January amounted to $6,347,477, as against $6,722,524 for the same month of 1919, a slight decrease for both the month and from the monthly average maintained during 1919.

For the first seven months of the governmental fiscal year the total exports were $46,829,905, which, compared for the same period in 1919, shows an increase of $8,000,540, the 1919 figures being $38,829,365. The seven months' increase indicates that the total exports for the year ending June 30, 1920, will run well over the $100,000,000 mark.

The above figures are gleaned from the monthly summary prepared by the United States Bureau of Foreign and Domestic Commerce. The following classified figures give the detailed data for January, compared with the corresponding month last year:

	1920.	1919.
Batteries	$ 374,730	$ 345,811
Carbons	139,640	189,351
Dynamos or generators	413,293	249,853
Fans	29,587	176,526
Heating and cooking apparatus	113,819	98,515
Insulated wire and cables	661,842	804,481
Interior wiring supplies, including fixtures	168,889	194,565
Lamps—		
Arc	90	206
Incandescent—		
Carbon filament	7,133	20,034
Metal filament	211,697	578,175
Magnetos, spark plugs, etc.	261,542	279,174
Meters & measuring instruments	188,123	324,404
Motors	733,872	680,882
Rheostats and controllers	18,558	48,436
Switches and accessories	294,036	177,159
Telegraph apparatus, including wireless	183,404	56,541
Telephones	230,186	214,172
Transformers	350,364	309,028
All other	1,966,672	1,975,211
Total electrical machinery and appliances	$6,347,477	$6,722,524

PACIFIC COAST SECTION, N. E. L. A., GAINS IN MEMBERSHIP.

Pres. R. H. Ballard of the National Electric Light Association was given a preliminary report on membership April 1 by Harry N. Sessions, chairman of the Membership Committee of the Pacific Coast Section of the National Electric Light Association and also a member of the National Membership Committee.

Mr. Sessions' report shows that since he began his work in November, 1919, he has secured approximately 2000 additional members to the national organization within the territory under his jurisdiction. President Ballard is gratified at the splendid showing of increased membership from the far west, and it is believed that when the national convention meet in Pasadena on May 18 that the membership secured by Mr. Sessions will run into yet higher figures.

In round numbers the Class "B" membership taken out by employes of the Southern California Edison Co. is approximately 900, and from promises made by other central-station companies in California, a total Class "B" membership of about 1800 is assured. Both President Ballard and Chairman Sessions are pleased at the splendid response which they have been receiving from contractors, dealers, jobbers, manufacturers, architects and those engaged in branches of manufacture in which electricity is largely used, being represented by approximately 400 new memberships.

Mr. Sessions' work has been so thorough that practically every village and hamlet in the Pacific Coast states is now represented by memberships in the national organization.

WISCONSIN ASSOCIATION DISCUSSES RURAL LINE EXTENSIONS.

Subject Takes Up Considerable Time at Second Day of Annual Convention—Special Committee to Continue Work of Investigation.

Practically all of the second day of the annual convention of the Wisconsin Electrical Association at Milwaukee, March 24 and 25, was devoted to a discussion of the report of a special committee on rural line extensions. A full report of the first day's session of the convention was given in the March 27 issue of ELECTRICAL REVIEW.

The report on rural line extensions was presented by G. C. Neff, chairman of the committee and general superintendent of the Southern Wisconsin Power Co., Madison, Wis., and is printed on other pages in this issue. The members of the association present were in full accord with the report and the discussion was mainly confined to plans for enlarging the scope of the investigation into rural line extensions and how to obtain further data and information for the committee.

The committee was continued in power for another year and all companies doing any work in the line of rural extensions during 1920 will make a full report to the committee, giving cost of line extension, customers served, income from line, and all other data. Although no definite action was taken it was the consensus of opinion of the association members that financing of the construction of rural line extensions should be done by the farmers served and not by the companies. Figures submitted by various companies showed that income received from rural lines seldom averages enough to warrant a company in financing the construction of such lines.

An interesting paper on "Investment or Cost of Reproduction Less Depreciation" was read by Paul Stark, general auditor of the Eastern Wisconsin Electric Co., Sheboygan, Wis., in which he stated that the value of any public utility property is the legitimate cost incurred in establishing and developing its business. Continuing, Mr. Stark said that since the inauguration of state and government regulatory bodies, the true significance of the word "valuation" had evidently been lost and only a vague and indefinite idea remains as to just what comprises a true and just valuation.

The practice, he said, now prevalent among

the state public service commissions in arriving at a valuation to be used for rate making purposes, is based on the "cost of reproduction less depreciation" theory. To the theoretical valuation expert and the "professional depreciator," the theory has unlimited possibilities. By its application the valuation of a public utility can be so warped that only the naked and bare bone skeleton remains, and only that part which, according to the investigator, the utility is entitled to use as its value for rate-making purposes.

E. M. Walker, general manager of the Terre Haute, Indianapolis & Eastern Traction Co., Terre Haute, Ind., read a paper on "Possibilities of City Street-Car Operation," in which he gave some advanced ideas in handling traction problems. "The Development of the Automatic Substation" was the subject of a paper read by C. A. Butcher, of the switchboard engineering department of the Westinghouse Electric & Manufacturing Co. Moving pictures illustrating the methods of creosoting and butt-treating poles were shown by the Barrett Co.

In his annual address to the association, President W. C. Lounsbury, general superintendent of the Superior Water, Light & Power Co., Superior, Wis., said: "Central-station companies are selling their service for less than it is worth, but great as is this, as well as other problems that confront the industry, they are not too great to be overcome. One of the best ways to overcome any of the problems that confront the central-station companies right now is to obtain and hold the confidence of the public."

At the annual election, March 25, Mr. Lounsbury was re-elected president of the association, the other officers being as follows: First vice-president, L. N. Boisen, vice-president, Ashland Light, Power & Street Railway Co., Ashland, Wis.; second vice-president, Harold Giesse, vice-president, Wisconsin Power, Light & Heating Co., Milwaukee, Wis.; third vice-president, P. D. Kline, general superintendent, Wisconsin-Minnesota Light & Power Co., Eau Claire, Wis.; secretary and treasurer, J. P. Pulliam, Wisconsin Railway, Light & Power Co., 1408 First Wisconsin National Bank building, Milwaukee, Wis. The next convention will be held in Milwaukee in March, 1921, the exact dates to be announced later.

SOUTHERN CALIFORNIA EDISON CO. FIXES DUTIES OF OFFICERS.

In order to take care of the Southern California Edison Co.'s extensive plans for water-power development, involving 500,000 hp. of hydroelectric power during the next eight years, some changes in the duties of the officers were made at the meeting of the board of directors, following the annual stockholders' meeting on March 19. John B. Miller was elected chairman of the board of directors and president of the corporation.

Other officers elected and their duties are as follows: W. A. Brackenridge, senior vice-president in charge of water-power development; R. H. Ballard, vice-president and general manager; G. C. Ward, vice-president in charge of operation and construction; A. N. Kemp, vice-president and comptroller; S. M. Kennedy, vice-president and general agent in charge of business development and public relations; A. E. Morphy, secretary; W. L. Percey, treasurer, and R. V. Reppy, general counsel.

NEW YORK SECTION OF N. E. L. A. HOLDS MARCH MEETING.

The March meeting of the New York Companies section of N. E. L. A. was held on March 16 at the auditorium of the New York Edison Co. building on 23d street. The meeting, at which the attendance was approximately 300, served as a get-together affair for the members and guests. A program consisting of addresses by Major F. H. La Guardia, president of the Board of Aldermen of New York City, and by Walter Neumuller, secretary of the New York Edison Co., was followed by a midnight supper and dancing.

Major La Guardia spoke on Americanism and Mr. Neumuller on service as viewed from behind the scenes. In his talk on service, Mr. Neumuller discussed the problems that confront the utilities companies from the time the coal is delivered to the power house until the bills are collected for the service rendered.

HARTFORD ELECTRIC LIGHT CO. TO BUY CONNECTICUT POWER CO.

The Hartford Electric Light Co. has arranged through Stone & Webster, Boston, for the purchase of the holdings of the Connecticut Power Co., which operates a large hydroelectric power service in the Housatonic river and Western Connecticut districts under a charter that grants state-wide powers. When the deal is completed the Hartford company will be serving New London, Middletown, Portland, Glastonbury, Norfolk, Canaan, Torrington, Thomaston and other cities and, through the recently opened dam and power plant, will be able to conserve coal and provide cheaper electric power.

The Hartford company will issue 7500 shares of stock of a par value of $750,000 and will exchange this for $1,000,000 of the common stock of the Connecticut company.

ILLINOIS CHIEF ENGINEERS TO MEET AT STATE UNIVERSITY.

The second annual meeting of the chief engineers of Illinois state institutions will be held at the University of Illinois, Champaign, Ill., on April 8, 9 and 10, when a full program has been prepared for the entertainment of the visitors.

On April 8 there will be an inspection trip through the University of Illinois power plant and testing laboratories, conducted by J. Morrow, superintendent of building and grounds; followed by a paper on "Efficient Boiler Plant Operation," by Prof. A. P. Kratz, University of Illinois. The afternoon session will be devoted to papers on coal mining and coal analyses, with papers by S. H. Viall, Prof. H. H. Stoek, Prof. S. W. Parr and J. M. Lindgren. On Friday evening the delegates will attend the electrical

show at the university gymnasium. Saturday morning F. J. McCullough, assistant supervising engineer of the university, will read a paper on "Safe Electric Wiring."

WINDSTORM CAUSES HEAVY LOSS TO UTILITY COMPANIES.

Damage amounting to about $1,000,000 was done to public utility companies operating in northern Illinois March 28, when a windstorm swept from Elgin to the northern suburbs of Chicago, and went out over Lake Michigan.

Despite the heavy property loss there was comparatively little delay in service on the part of any of the utility companies, except those serving the city of Elgin, which was the hardest hit by the storm. The Chicago Telephone Co. suffered a loss estimated at $500,000 in damage to exchanges and pole lines. The Commonwealth Edison Co., Chicago, was more fortunate and except in isolated cases where wires leading to individual buildings were put out of commission, suffered no loss of service. The same was true of other lighting companies serving the district.

CONVENTION TRANSPORTATION PLANS BEING COMPLETED.

G. W. Elliott, master of transportation of the National Electric Light Association, was in Chicago this week completing arrangements with the western railroads for the transportation of members of the association to the annual convention in Pasadena, Cal., May 18-22, inclusive.

"The outlook at the present time," said Mr. Elliott, "is that in order to handle the convention visitors it will be necessary to provide additional equipment on regular trains, while the demand for space on the 'Red Special' of the N. E. L. A. is so great that it may be necessary to run the train in two sections."

Persons in the Chicago district desiring transportation accommodations should communicate with G. H. Atkin, assistant master of transportation, 613 Marquette building, Chicago.

EDISON CLUB OF CHICAGO ARRANGES "LIBERTY DAY" PROGRAM.

Planning to make a country-wide movement through co-operation of central-station companies and later to interest other organizations in making the day a national holiday, the Edison Club of the Commonwealth Edison Co., of Chicago, has planned a "Liberty Day" celebration to be held April 6, the anniversary of the date on which the United States entered the world war. George H. Harries, vice-president of the H. M. Byllesby & Co., Chicago, will be the principal speaker at the celebration.

SENATE FINANCE COMMITTEE TO AID TUNGSTEN OUTPUT.

The Finance Committee of the United States Senate has favorably reported on a bill to promote the production of tungsten ore and manufactures thereof in the United States. The bill provides that for three years after the passage of the act, duties are to be collected on tungsten bearing ores and concentrates at $9 per unit of tungstic trioxide contained therein, the unit being defined as 20 lbs.; on metallic tungsten powder, acids and salts of tungsten and scrap steel containing tungsten fit only to be manufactured, and all other compounds containing tungsten, 0.9% per pound for each of said substances for each per cent of tungsten contents; on high-speed tungsten steel and all alloy steels containing tungsten, 35% *ad valorem*.

"THOUSAND NEW MEMBERS BY JULY" IS S. E. D. SLOGAN.

The Society for Electrical Development has adopted the above slogan in a membership drive just inaugurated. Since the signing of the armistice the membership of the organization has been increasing, but this growth is to some extent due to members returning to the organization after having been forced to withdraw during the war.

The society has mapped out an extensive direct-by-mail campaign and the first of this series has gone out in the form of a letter setting forth briefly a few of the advantages of membership in the society.

O. B. BLACKWELL GIVES TALK TO CHICAGO ENGINEERS.

O. B. Blackwell, transmission development engineer of the American Telephone & Telegraph Co., spoke on "Transmission of Intelligence" at the regular weekly meeting of the Western Socoiety of Engineers, Chicago, on March 29. Commencing Friday, April 2, the society instituted a weekly noonday luncheon at the Hotel Morrison with Samuel Insull, president of the Commonwealth Edison Co., Chicago, as the speaker at the first luncheon. Mr. Insull's subject was "The Engineers' Influence in Public Utilities."

ROCHESTER SECTION HEARS TALK ON RAILWAY SIGNALLING.

C. F. Estwick, of the General Railway Signal Co., was the principal speaker at the last meeting of the Rochester Section of the American Institute of Electrical Engineers, held in the rooms of the Rochester Engineering Society on March 26. Mr. Estwick spoke on "The Track Circuit in Railway Signalling." The paper was followed by a general discussion.

STEAM TURBINE IS DISCUSSED AT MILWAUKEE.

At a meeting of the E. M. B. A. Technical League of the Milwaukee Electric Railway & Light Co., held in Milwaukee March 25, H. E. Flory, manager of the steam turbine department of Allis-Chalmers Mfg. Co., presented a paper on the developments of steam turbines, special attention being paid to the economies effected by their use.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

CO-OPERATIVE SALES METHODS USED IN BROOKLYN.

Central-Station Company Adopts Broad Policy of Co-operation with Dealers, Contractors, Jobbers and Manufacturers.

By W. H. Wells,

Edison Electric Illuminating Co. of Brooklyn.

The Edison Electric Illuminating Co. of Brooklyn was among the first central-station companies in the country to recognize the value and need of proper relations between all factors of the electrical industry. About ten years ago, at the suggestion of this company, the "Kilowatt Club" was formed in Brooklyn, the membership consisting of central-station men, contractors, jobbers and manufacturers; in fact, any one having to do with the electrical industry in any form was eligible. The main object of the club is to promote a better and closer understanding between the different factors of the industry and to give the members an opportunity at least once a month to discuss subjects of mutual interest.

The Brooklyn Edison house-wiring plan was one of the co-operative ideas worked out. Hundreds of old residences have been wired for electric light on this plan—over 1000 were wired in 1919. The central-station company finances the proposition, the Brooklyn contractors do the wiring and a Brooklyn manufacturer produces the fixtures—it is co-operative to the last degree. All of the selling expense falls on the Edison company, such as canvassing for the business, advertising and publicity. The jobs are turned over to the contractors, who are paid by the central-station company on presentation of certificates. As stated above, a great many houses have been wired on this plan since its inception, but a great many more have been wired by the contractors, the business obtained being partly due to the extensive publicity and advertising on house-wiring.

Jan. 1, 1917, the Brooklyn Edison Co. took another radical step, that of withdrawing its free-renewal policy on lamps. This put the sale of incandescent lamps in Brooklyn on a merchandising basis, lamps being sold at list only. Naturally, the company watched the sale of lamps in its territory, to make sure the field was not being neglected and empty sockets resulting therefrom. In 1916 the company did practically all the lamp business in Brooklyn. The first year under the new conditions the contractors did 40% and the company 60% of the lamp business; the second year the contractors did 60% and the company 40%, and in 1919 the change was even greater.

All this business comes to the contractor among other reasons because the general sales agent of the Brooklyn Edison Co. appreciated that it was a good co-operative policy to adopt and was able to convince his superiors of its merits—and he certainly was correct in his assumption.

A form of co-operative merchandising was

10 THE BROOKLYN DAILY EAGLE. NEW YORK TUESDAY. DECEMBER 16, 1919.
Make It an Electrical Christmas
What is more in sympathy with the bright Christmas Season than electrical gifts—sparkling in their nickel or silver with a promise to make homes modern and life easier and happier! Santa Claus is using up-to-date sales methods this year and has established electrical headquarters in your neighborhood for your use. Find the nearest dealer's name on the list below. He is waiting to supply you with tasteful electrical gifts for Christmas and your requirements of Mazda Lamps. Buy from men who know
These Dealers Will Supply Your Electrical Wants
MANHATTAN
Here are a few of the Electrical Gifts on sale at the shops listed below
Electric Toaster
Electric Washing Machine
Electric Heating Pad

Sample of Co-operative Advertising to Stimulate Sale of Electrical Appliances.

tried in New York quite recently when the central-station companies, contractor-dealers and jobbers formed a good sized pool to run full-page advertisements in the New York dailies advocating electrical Christmas gifts. It is just another step toward a better understanding

Dealers' Window Display in Brooklyn Dressed with Material Received Through Co-operation of Other Branches of Industry.

among the members of the electrical fraternity. So many electrical dealers have failed to recognize the value of advertising. They have operated in a very small circle—never beyond They could not get beyond that small circle because they would not risk the money to advertise themselves into a larger circle and small they always will remain unless they adopt the co-operative spirit and get together with some general publicity plan which will help them individually and collectively.

TRANSMISSION LINE NOW LINKS FOUR MIDDLE WEST STATES.

Line Connecting Iowa, Illinois, Indiana and Kentucky Completed by Central Illinois Public Service Co.

Announcement by the Central Illinois Public Service Co. of the installation of 169 miles of additional high-tension transmission line, making a total of 1,354.88 miles, traversing 31 counties in the central section of Illinois, means the linking up of the four states of Iowa, Illinois, Indiana and Kentucky on a great new high-power eletcric line and marks an extraordinary step in the development of electric power facilities and utility service in Illinois.

Greater industrial activity in that section of the state is being looked forward to in connection with the development of electric power facilities. Already a number of new manufacturing concerns have opened plants and commercial clubs along the route of the line have been actively campaigning to attract these new industries to their communities. In several cities and towns "booster" organizations are at work, heralding the advantages of their localities and advertising what unlimited and unfailing electric power means to industrial concerns. So insistent has been the power demand that the company, in spite of present high construction costs, shortage in electrical equipment supplies and high prices for needed capital, has found it necessary to bend every effort towards speeding up the work.

When the development is finally completed Warren and Henderson counties on the far west, Perry, Franklin, Jackson, Williamson, Saline, Gallatin, Union and Pulaski on the far south, and Livingston, McLean, Ford and Iroquois on the west side of the state will be joined with the other counties on the line.

A short link of 9 miles between Paris and Kansas, Ill., erected a short time ago, was the final step in completing the 33,000-volt transmission line extending across the state of Illinois from Keokuk, Ia., on the west, to Paris on the east. This interconnected transmission system is now furnished energy by the Mississippi River Power Co. at Keokuk, Ia.; in the central portion by the company's large steam generating station located at the mouth of the mines at Kincaid, Ill.: and from the east by the Terre Haute, Indiana & Eastern Traction Co.'s generating station, located at Terre Haute, Ind.

As a further step towards linking up Indiana and Kentucky with this line, the company has placed in operation 10 miles of new 33,000-volt transmission line extending from Vincennes, Ind., to Lawrenceville, Ill., and 22 miles of similar line extending from Bridgeport, in Lawrence county, to Stoy, in Crawford county. These lines are under lease in connection with a contract for the purpose of furnishing energy to supply this district from the Indiana Power & Water Co.'s new large generating station at Edwardsville, Ind. This latter new development will permit the shutting down of several small, uneconomical and inefficient plants, among them being those at Olney, Lawrenceville, Robinson and Palestine, and will give those communities the benefits of the big power development.

UTILITY INFORMATION COMMITTEE ISSUES BULLETIN.

The Illinois Committee on Public Utility Information has issued a 20-page bulletin called the "speakers' bulletin," which will be used for the purpose of furnishing authoritative information on public utility and other electrical matters to men who will speak on different occasions for the committee.

In addition the bulletin is designed for use by employes, officials, bankers, lawyers, commercial association heads and professional men of all character who may have an interest, direct or indirect, in public utility companies. The bulletin is prepared under the direction of experts in public speaking and will be issued monthly.

Contained in the first bulletin issued are authoritative definitions, facts, statistics, statements of experts and similar data for use in public addresses together with other suggestions for speakers. Copies of the bulletin can be obtained from Bernard J. Mullaney, director, Illinois Committee on Public Utility Information, 209 South Dearborn street, Chicago, Ill.

OPERATING PRACTICE

Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

INTERESTING STATISTICS ON LINE OPERATION.

A report of the transmission department of the Georgia Railway & Power Co., Atlanta, Ga., for the past year shows some interesting statistics on operating conditions in connection with the lines of that company.

The number of insulators removed on the 616 miles of lines operated was 18,647 during the twelve-month period, the number installed being 23,575. About 99% of this work was done with the lines alive. Of 123,069 insulators tested, 13,196 were found defective. The testing was done with a "buzz stick," and the cost was $2,624.58, which represents an extremely low figure for this kind of work.

The number of poles reinforced was 501, the number reset 219, and replacements 105.

During the year the company rebuilt 98 miles of line, this work including change of construction and insulators and other repairs necessary in order to operate at a higher voltage. Nearly all of this construction was done while the lines were alive.

The lines were patrolled twelve times during the year, making a total of 7392 miles covered. The 14 trucks used by the department had a combined mileage of 151,790.

USE OF STEAM JETS FOR CUTTING CLINKERS.

Time, Labor and Heat Are Conserved in Simple Manner.

By M. A. Simpson.

In one of the large central stations, the demand for steam during the day had increased so rapidly that practically no reserve capacity was available, and boilers in service were worked at such high rates of evaporation that the stack capacity was severely taxed. Each boiler was served by an underfeed stoker, each with its individual blower, yet the rates of combustion were so high and the draft such that a positive pressure existed in the furnace chamber.

The fires rapidly became choked and it was necessary to clean each fire every ten minutes and sometimes less. Every time the fire doors were opened, flame and gases came out, because of the inability of the stacks to carry away the gases of combustion. The work of cleaning fires was a hot and dirty task. The grates had large surface and sluice bars 14 ft. in length were used. Bars of such length are very unwieldy, they are hard to handle and soon become heated to a red heat when in the furnace. When this happens, the rods bend and become even more difficult to handle and less useful for their purpose.

In the plant in question, the grate was inclined so that the rear of the fire was out of reach of the fireman standing in the pit beside the stoker retorts and cleaning the fire with his 14-ft. sluice bar. A manually operated dump plate was used and the clinker often assumed such size as to be almost unmanageable for the distance. It was not feasible to work upon the clinker from the side, because the boilers were located too close together to allow the sluice bar to be used that way.

The problem has been solved by employing a steam jet to cut up the clinker as it lodges between the dump plate and the bridge wall. A ½-in. pipe, open at the end, is connected to a steam line. This pipe is made as long as the distance between boilers permits. The side door is opened and the pipe introduced into the furnace when the steam is turned on. The steam jet is then moved along the clinker, cutting it where the steam impinges on the clinker mass. In this way unmanageable clinker can often be made less difficult to handle.

CORRECTING A FAULT OF A RELAY.

By J. H. Robertson.

The writer has recently had some experience with a troublesome starting relay, the remedy for which is so simple that the information is passed along with the hope that it may prove of benefit to others who may be experiencing a similar trouble.

The relay referred to is a starting relay on an automatic starting panel for a 25-hp. slip-ring induction motor driving an air compressor. The motor voltage is 2200, while that of the control panel is 220. The equipment maintains a pressure of 40 lbs. maximum and 20 lbs. minimum on an air reservoir and, of course, a pressure gauge is part of the equipment. While the compressor is operating the relay is not energized, and the armature is held down by gravity. When the pressure reaches 40 lbs., the relay coil becomes energized, drawing up the armature, opening the control circuit and stopping the motor. The armature is held in this position until the pressure falls to 20 lbs., when the other contact is made, breaking the relay circuit, allowing the armature to drop and again starting the motor.

After a few weeks' operation the equipment would fail to start sometimes once or twice a day, allowing the pressure to fall to zero. The relay would have to be tripped by hand to start the motor. The conditions were explained to the manufacturers of the apparatus and a new pressure gauge was furnished, but this failed to remedy the trouble. The situation became so troublesome that a bell circuit was rigged up so that a warning was sounded before the pressure fell to zero.

Investigation finally revealed the fact that the

trouble was not in the contact-making pressure gauge, but that the relay armature would not drop with no current in the coil, this being due to residual magnetism in the relay cores. The construction of the relay was such that there was a stationary core at the top and the armature or movable core at the bottom. When the armature was pulled up the two cores came in contact with one another, and at times the residual magnetism was sufficient to hold up the armature, after the circuit had been broken, with the above mentioned results.

A very simple remedy for this trouble was the placing of a thin brass disc on top of the armature so that the two cores could not come in contact with one another. Since this has been done there has not been a failure and I consider that my troubles from this source are at an end.

CARBON TETRACHLORIDE REPLACES OIL IN CIRCUIT-BREAKERS.

The objections of transil oil in circuit-breakers have long been recognized, yet little progress has been made in finding a substitute. Many substitutes have been proposed but the only one that has met the conditions existing to any extent has been carbon tetrachloride.

Transil oil is inflammable. Under certain conditions it is explosive, as when oil fumes form upon the top of the switch tank and become admixed with air in the right proportion to form an explosive mixture. Should a spark occur, the tank may be blown off and other damage done This condition is partially overcome by installing vents so that if an explosion occurs, pressure will not build up; another method is to introduce positive air circulation along the surface of the oil, in this way carrying off whatever fumes may form.

Carbon tetrachloride is now being used, in an experimental sort of way, it is understood, by the Commonwealth Edison Co. Its possibilities seem worth determining where cramped locations and special conditions may make the fire hazards of transil oil specially objectionable, for example, explosives factories, aboard ship and other similar places. In using carbon tetrachloride, it is well to bear in mind that it is a very powerful solvent for rubber; it is quite an effective anaesthetic (a matter to be borne in mind where free access to the atmosphere is not feasible), and evaporates readily.

CABLEWAYS FOR LEAD-COVERED CONDUCTORS.

The problem of routing large lead-covered underground conductors into and out of buildings is not always an easy matter. Such conductors are heavy and difficult to handle, space may be difficult to find, and building restrictions may interfere, while the fact that it must be possible at all times to be able to pull out or pull in cables for making repairs, etc., only adds to complicate the situation.

Whereas it used to be the custom to pull in these conductors through ducts, or to lay them on the floor and pour concrete over them, simpler, cheaper and more convenient methods are in vogue. In the illustration is shown a method used by the Commonwealth Edison Co., Chicago, in a number of its substations for transforming from 12,000 to 4000 volts, and where a large number of 4000/2300-volt feeders have to be routed into and out of a substation. The cables are supported by a run of sheet iron carried by steel rods fastened into the ceiling and bolted at their bottom ends to a strip of iron. The cables keep the sheet iron firm and rigid because of their weight. Each conductor is covered with split duct, which is tied around with wire. In this way a minimum of work for installation suffices, and the cables are ready at all times for repair and inspection. The good air circulation does not impose current-carrying capacity limitations nor do building considerations do so.

Method of Carrying Cables on Sheet-Iron Runway Supported from Ceiling.

ELECTROLYTIC PROTECTION OF CONDENSER TUBES.

In one of the sections of the fifth report of the Corrosion Committee of the British Institute of Metals, which held a conference in London on March 11 and 12, there was given an account of preliminary work on the electrolytic protection of condenser tubes. The particular question investigated was that of the efficiency of electrolytic protection in preventing deposit attack, i. e., attack by cupric chloride solution. A piece of 70:30 brass tube made cathode to strip iron in a normal cupric chloride solution was very distinctly attacked despite the small current passing from the solution to the brass.

It is considered that an electric current slows down but does not necessarily inhibit corrosion of a cathode. By raising the current density sufficiently it is possible that all corrosion even in a cupric chloride solution may be prevented. Experiments have shown, however, that a current as large as 20 to 25 amperes per 1000 sq. ft. is insufficient to prevent a 70:30 brass tube from being rapidly corroded by such a dilute solution of cupric chloride as a one-twenty-fifth normal solution. Some suggestions are made in the report whereby the usefulness of the electrolytic protection process may be extended by special manipulation of it in the early part of the life of a tube, with the object of forming a thin continuous layer of calcium carbonate over the surface of the tube.

CONTRACTING-CONSTRUCTION

A Department Devoted to Various Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

ELECTRICAL COMMITTEE TAKES ACTION ON CODE CHANGES.

Recommendations at Recent Public Hearing Generally Adopted, Except Limit of Low-Potential System Fixed at 600 Volts.

The Electrical Committee of the National Fire Protection Association has issued an abstract of the action taken by the committee following the public hearing held in New York City March 23 regarding the changes recommended for revision of the 1918 edition of the National Electrical Code. These suggested changes were outlined in a bulletin issued by the Electrical Committee some four or five weeks previous to the public hearing. They were abstracted and printed in the Feb. 21, Feb. 28 and March 6 issues of ELECTRICAL REVIEW, and reference should be made to these issues in order to clarify the outline of the action of the Electrical Committee given below.

The committee fixed the limit of low-potential system at 600 volts instead of 750 volts, as recommended in various sections of the bulletin.

The proposal to require polarity identification in all wires installed on and after Jan. 1, 1921, was modified to require that beginning July 1, 1921, twin wires for conduit work and twisted pair wires for armored cable in sizes No. 12 and 14 B. & S. gauge provide the means for continuous identification proposed in the bulletin for Rule 26*a*. Rule 77 on fixtures is to be revised to require identification marking by the fixture manufacturers of the wire connected to the screw shells of sockets.

A committee is to be appointed to consider requirements for the installation of concealed extensions from existing wiring in buildings of fire-resistive construction.

The following takes up in the order of the bulletin and the abstracts of it made in issues of ELECTRICAL REVIEW, before mentioned, the various committee reports considered at the public hearing, and indicates the action taken by the Electrical Committee.

Committee on Cars and Railways.—The report was adopted substantially as printed in the bulletin.

Committee on Devices and Material.—The report was adopted with minor changes; limits for general use of varnished cloth insulated wire for general use were set at sizes No. 6 B. & S. gauge and larger.

Committee on Fixtures, Heaters, Signs and Lamps.—Under fixtures, Rule 30*a*, the following rule was added: "Insulating joints may be omitted in the case of straight electric fixtures installed on grounded raceways when the grounded wire of the circuit is connected to the screw shell and when approved fixture wire is used." The other recommendations were adopted without essential change, except that no action was taken on recommendations for rules on electric pressing irons.

Committee on Generating and Substations.—The report was adopted; in addition the committee was asked to consider amendments to Rule 1*d* to exclude from its application equipments of public utilities.

Committee on Grounding.—Recommendations were adopted, but the grounding of generators operating at 150 volts or less and not accessible to other than qualified operators is not to be required. Recommendations as to ground detectors were approved. Recommendations as to grounding of motors were adopted with same provision for omitting grounding for motors operating at 150 volts or less and not accessible to other than qualified operators. The remaining sections of the report were adopted substantially as printed, except for the definition of low-potential systems and the polarity identification of wire referred to above.

Committee on Industrial Applications.—The report on overload protection of motors was referred back to the subcommittee for conference with representatives of the industries interested. The report on size and protection of conductors on motor circuits was referred back to the subcommittee with instructions to continue the last paragraph of present Rule 8*c*. The recommendations on motor switches were approved, but the report was referred back to subcommittee for rewording after consideration of the problem of large switches. The recommendations on high-potential systems were adopted, while those requiring externally operated inclosed types of switches for motor circuits were not adopted. The balance of the report was adopted.

Committee on Outside Wiring, Building Supply and Service.—The recommendations as to Rules 12, 13, 17*b* and 23*a* were adopted, except that Section *e* of present Rule 13 is to be retained. The recommendations as to 24*a* were adopted, except that preference was stated for the use of externally operated switches and for requiring an additional service switch in the case of sealed equipment. The recommendations as to oil-immersed transformers were adopted, though drains in vaults will not be required in certain cases. The balance of the report of the committee was adopted substantially as printed.

Committee on Signaling Systems.—The report on Rule 85 was adopted. New Rule 86 on radio equipment was adopted, but with changes and minor details as to equipment. The committee was requested to consider the use of resistance devices instead of spark gaps.

Committee on Theaters, Motion Pictures, Places of Public Assembly and Garages.—The

report was adopted without any essential changes.

Committee on Wiring Standards and Systems.—Recommendations as to conduit work, sizes of wires, etc., were adopted. In considering wattage limits for branch lighting circuits the recommendation on Rule *23d* not to require special permission for 1320 watts on circuits with medium base sockets was not adopted; approval was not made of the suggestion to change 1320 to 1500 watts. Provision was made for circuits up to 4000 watts when mogul sockets are used, but special permission will be required. Referring to Rule 34, circuits of 4000 watts will be allowed by special permission. As to Rules *26g* to *26j*, the wording of the 1918 Code is to be retained except for the addition of the last sentence in proposed Rule *26j* and except for the recognition of varnished cloth insulation. The recommendations as to low-voltage lighting systems were referred back to the subcommittee for editing. Recommendations for futher consideration of the matter of inclosure of switches and fuses, referred to in Rules *19b* and *19c*, were approved. The recommendations as to interbuilding connections and special items were

Committee on Reconciling the National Electrical Code and the National Electrical Safety Code.—The report was adopted except that the present Rule *15As* is to be retained.

GRIPPING PIPE OR CONDUIT WITH AN ORDINARY WRENCH.

By E. T. Paul.

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Four different methods of improvising wrenches for gripping wrought-iron pipe or conduit are shown in the accompanying illustrations. It is seldom that emergency conditions will be such that one can not provide a workable wrench in accordance with one of the methods shown.

With the flat-file method of Fig. 1, the opening between the jaws of the drop-forged wrench should be somewhat larger than the diameter of the tube to be handled. Then a piece of flat file is placed between the pipe and the jaw and, if necessary, it is wedged up against the conduit. The teeth in the file will, if adjustments have been made properly, grip the tube firmly.

At Fig. 2 is shown another method wherein either a cap screw, a machine screw or a short piece of round file can be used in combination with the monkey wrench to grip the conduit. A square-headed cap screw is better than either the machine screw or the file, because the two latter members tend to roll from the jaws of the wrench. This method is used to best advantage

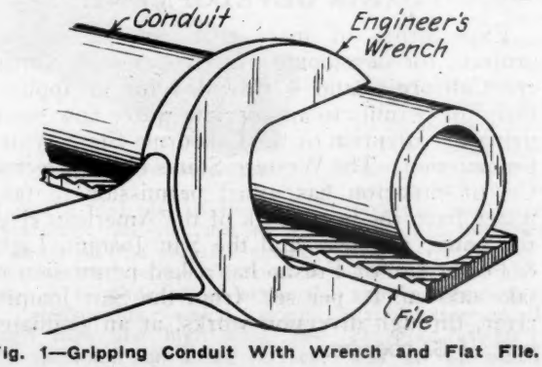


Fig. 1—Gripping Conduit With Wrench and Flat File.

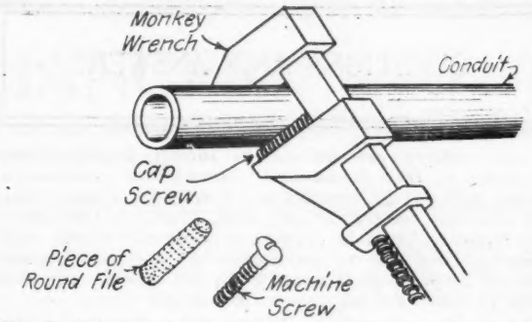


Fig. 2—Gripping Conduit With Wrench and Round File or Saw.

with conduits of diameters less than, possibly, three-quarters of an inch.

In Fig. 3 a piece of round file and a monkey wrench are employed. In using this scheme the jaws of the wrench are first opened just wide enough to admit the pipe, then the short piece of round file is inserted as indicated. If the handle of the wrench is pulled (toward the reader in the illustration shown) the file rolls into position and

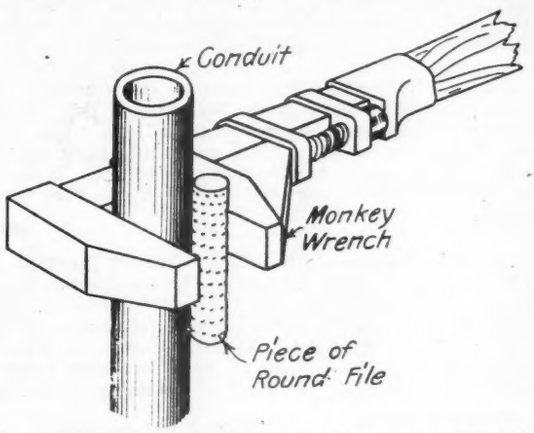


Fig. 3—Another Method of Gripping Conduit With Wrench and Round File.

wedges and binds the conduit quite firmly. Reversing the pressure on the wrench handle will instantly release the file.

Fig. 4 depicts a method of turning a piece of conduit with a rope or cord and a piece of metal pipe or rod. The illustration is self-explanatory. In some cases, a piece of heavy copper wire or soft-iron wire can be wrapped around the conduit about as indicated and thereby made to perform the function of the cord.

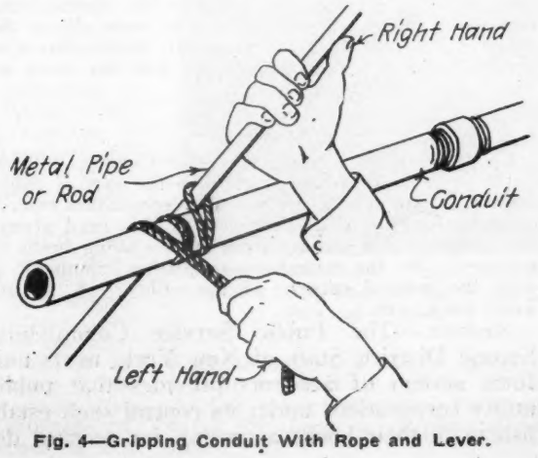


Fig. 4—Gripping Conduit With Rope and Lever.

QUESTIONS AND ANSWERS

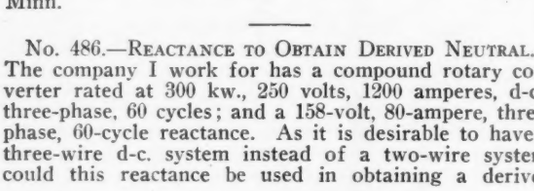
All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 475.—Pricing Motor Repair Work.—Can some of the readers through the questions and answers column give me the best methods of pricing repair work on electric motors, armature winding, etc., and the best methods of setting the selling price of insulating materials and of magnet wire?—D. D., Indianapolis, Ind.

No. 485.—Alternator Causes Flickering of Lamps.—In the plant where I work we have a 25-ampere, 2300-volt, three-phase alternator driven by a 75-hp. Corliss engine, which we run on at peak periods. This unit is about 25 miles from the main plant. When the alternator comes in, bad flickering commences which does not stop until the alternator is cut off. What can be the cause and remedy? Cards taken on the engine show it to be all right and the alternator has the correct speed. I have cut off the steam on the engine and disconnected the valve gear, running the alternator as a synchronous motor, and the flickering is then worse than when the engine is carrying the load. The unit was first installed in the main generating plant before being moved and no trouble was experienced. Is hunting or unbalanced phases the cause?—E. A., Pine City, Minn.

No. 486.—Reactance to Obtain Derived Neutral.—The company I work for has a compound rotary converter rated at 300 kw., 250 volts, 1200 amperes, d-c.; three-phase, 60 cycles; and a 158-volt, 80-ampere, three-phase, 60-cycle reactance. As it is desirable to have a three-wire d-c. system instead of a two-wire system, could this reactance be used in obtaining a derived



Proposed Method of Deriving Neutral for Three-Wire Circuit.

neutral as illustrated? Would it take the place of the regular reactance between a rotary and its transformers?—L. S. K., Hammond, Ind.

No. 487.—Use of Asbestos Magnet Wire.—I have been told that asbestos magnet wire has some advantages over cotton and enamelled wire, especially in the repair of motors which are frequently overloaded. Can someone give me their experience with this kind of wire?—F. J. K., Cleveland, O.

Answers.

No. 480.—Depreciation Reserve of Utilities.—What is the present prevailing practice on the part of public service commissions as to how the depreciation reserve of public utilities shall be kept? Is this fund always kept separate and distinct from other sinking funds or reserves? Do the commissions approve lumping it in with the general reserve of the utility?—A. E. M., Little Rock, Ark.

Answer.—The Public Service Commission, Second District, State of New York, in its uniform system of accounts provides that public utility corporations under its control shall establish upon their books a reserve for accrued depreciation to cover depreciation of plant and equipment and also to provide for obsolescence and inadequacy.

This reserve is established by charging to operating expenses month by month an amount which should be upon a basis determined to be equitable according to the corporation's experience and best sources of information and should in all cases be sufficient to provide during a period of years a reserve, against which can be written off all losses sustained upon the retirement of property, either when its natural life has expired or when it has become obsolete or otherwise inadequate for efficient service. The amount charged to operating expenses shall be concurrently credited to the account for reserve for accrued depreciation. When any capital is retired from service, the original money cost thereof (estimated, if not known, and where estimated, that fact and the facts upon which the estimate is based shall be stated in the entry), less salvage, shall be charged to this account.

This reserve is kept separate from any other reserve established by the corporation.—W. J. F., Albany, N. Y.

No. 484.—Gilsonite.—Can someone advise me as to what Gilsonite is? What are the properties of this material and where is it found? I understand that electrical insulating paints are made from this Gilsonite. If this is true, is the paint a good one for the windings of electrical machines?—B. D. M., St. Joseph, Mo.

Answer.—Gilsonite is a variety of asphalt which is found in fairly extensive deposits in the northeastern portions of Utah. It is practically pure bitumen and at normal temperature is very hard and brittle. When burned the ash is only 0.1%. Its specific gravity is about 1.070, varying but slightly in numerous samples. It is partly soluble in alcohol, more so in ether, and is completely soluble in chloroform. Warm oil of turpentine is also a very good solvent for Gilsonite. It is used with other bitumens for roofing preparations, road surfacing and paving materials, insulating paints and compounds, sealing compounds, etc.

As there is nothing inherently deleterious about the material itself, there is no reason to think that it would be harmful to coils and other insulated wires. If any paint in which it was incorporated were harmful, the injurious action would come from other ingredients and not from Gilsonite.—H. A. C., Pittsburgh, Pa.

PLAN LARGE EXPENDITURE IN CALIFORNIA DEVELOPMENT.

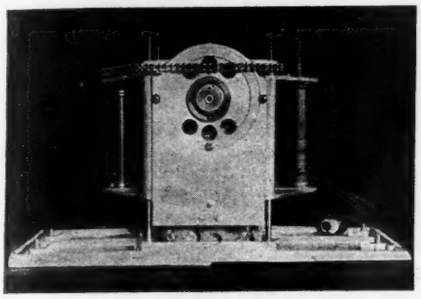
Expenditure of more than $11,000,000 in projects for developing 214,110 acres of Northern California land is provided for in applications for permits to appropriate water now occupying the attention of the California State Water Commission. The Western States Gas & Electric Co. of Stockton has asked permission to take water from the north fork of the American river for power purposes and the San Joaquin Light & Power Co. of Fresno has asked permission to take 900 cu. ft. per sec. from the San Joaquin river, through diversion works, at an estimated cost of $4,000,000.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

Portable Electrically Operated Machine for Flat Sanding.

On account of its easy portability, a flat-sanding machine recently placed upon the market by the Universal Machine Products Co., 320 North Ervay



Electrically Driven Portable Sanding Machine.

street, Dallas, Tex., can be used for the finishing of coaches, ships and many other large assembled pieces. According to the manufacturer, the machine can be used for many purposes in mills and woodworking shops. The sanding wheel is driven through gears by means of a Westinghouse universal motor which can be supplied with energy from a lamp socket on either a d-c. or a-c. circuit.

The depth of cut made by this machine is adjustable and can be changed instantly by turning the handle on the left. The device is claimed to be extremely economical, requiring few changes of sandpaper. The entire machine weighs but 20 lbs.

Commutator Resurfacer With a Double Attachment.

A new commutator resurfacer, designed for use with a portable or side-attachment resurfacing machine, is being manufactured by the Ideal Commutator Dresser Co., 10 South Dearborn Street, Chicago.

This new "Ideal" commutator resurfacer has a wooden shank which is

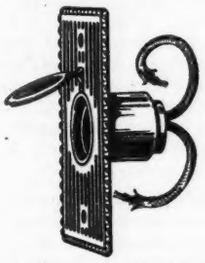
"Ideal" Commutator Resurfacer.

clamped in the tool rest of the resurfacing machine. By the use of the wooden shank all the abrasive composition can be used before the tool is discarded. It is made of an artificial abrasive composition which grinds down high bars and high mica, removes flat spots and puts a new surface on the commutator. Sparking and loss of power can be eliminated, the manufacturer claims, without the expense and inconvenience of shutting down and removing the armature.

The resurfacer is made of an artificial composition, uniform in density and with a uniform cutting surface that will not fill up with copper dust or wear smooth. This new tool is made in all suitable sizes.

New E-Z Wire Receptacle Makes Installation Easy.

Ease of installation is one of the features claimed for the new "E-Z Wire" receptacle, manufactured by the Peerless Light Co., Chicago, Ill., the only tools necessary for the installation being a brace, bit and screwdriver. It is a flush receptacle and plate combined, and simple and compact. Being cast in one piece, there are no parts to get out of order. The receptacle has two No. 14 wire leads.



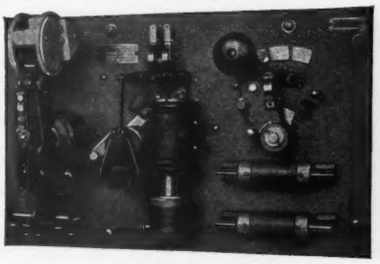
Ease of Installation Is Feature of New "E-Z" Receptacle.

All standard screw plugs used in electrical devices will fit the receptacle.

New Automatic Charging Section for Electric Trucks.

An automatic unit battery-charging section for the charging of electric trucks is a new product of the Cutler-Hammer Manufacturing Co., Milwaukee, Wis. This equipment consists of a single pole magnet switch, a solenoid relay, a main-line switch and two inclosed fuses, all mounted on a slate panel 15 in. high and 24 in. wide. The panel is drilled for mounting on the standard floor-type frame, which is capable of assembling from one to four sections. Each unit section will charge one vehicle, and the sections may be assembled as needed, similar to those of a bookcase.

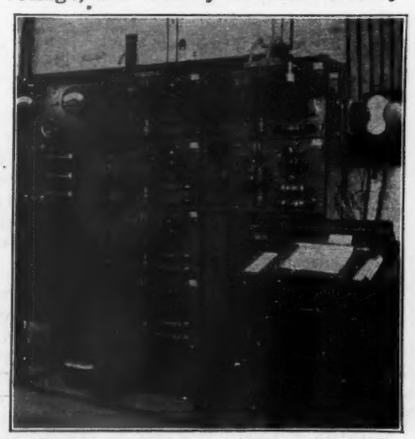
The charge is started by moving the main-line switch, which is mounted on the right of the panel, to the "on" position and inserting the charging plug into the battery receptacle. The main switch may be left in the "on" position and the charge started by simply plugging into the battery. The panel automatically takes care of the charging rate so it is properly tapered, and an attendant's presence is not necessary until the charge is completed, when he terminates it by moving the main switch to the "off" position or by pulling out the charging plug. Or the charge can be discontinued by the opening of a shunt trip circuit-breaker controlled by an ampere-hour meter on the vehicle.



Battery-Charging Section Panel, One to Four of Which Can Be Mounted on Standard Floor Type Frame.

The solenoid relay, which is set in motion by inserting the charging plug into the battery receptacle, is sufficiently retarded by a dash-pot to insure the plug being seated before the magnet switch closes to complete the circuit. A duplex meter mounted on a swinging bracket to the right of the frame section gives simultaneous readings of the charging current and battery voltage when the main switch is moved to the third or "meter reading" position. A spring automatically returns the switch from the "meter reading" to the "on" position.

The charge is automatically given a tapering rate by means of a fixed resistance, which is designed with a proper capacity for the battery to be charged. In case of failure of line voltage, the battery is automatically



Six-Circuit Sectional Type Battery-Charging Panel Installed for Charging Fleet of Trucks.

disconnected and thus protected against reversal of current. When the line voltage returns to its normal value, the charge is automatically resumed.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Bazart Lighting Co., New York City, has completed negotiations for the leasing of property at 8 Warren street, for a new establishment.

Allentown Storage Battery Co., Allentown, Pa., has completed the removal of its establishment to new quarters at Sixth and Walnut streets.

Austin, Gorham & McIlvaine, 144 North 3rd street, Philadelphia, Pa., have established themselves in business and will specialize in power installations, steam and electrical engineering.

Fahnestock Electric Co., Meadow street, Long Island City, N. Y., has taken bids for the construction of a new 2-story and basement plant to be located at East avenue and 8th street.

The Brown Instrument Co., Philadelphia, Pa., is erecting two new buildings at a cost of $100,000. One building will be used for the manufacture of recording thermometers and the second as a research department.

Scranton Electric Co., 509 Linden street, Allentown, Pa., is considering plans for the construction of a new 1-story brick machine shop, about 65 by 68 ft., at Washington avenue and Larch street, estimated to cost about $30,000.

Stone & Webster, 147 Milk street, Boston, Mass., have issued a leather-bound booklet giving in detailed form the information most commonly desired about the public service companies under the management of the organization.

Philadelphia Electric Co., Tenth and Chestnut streets, Philadelphia, Pa., is taking bids for the construction of the proposed new 1-story and basement concrete substation, about 76 by 95 ft., to be located at Marshall and Noble streets.

Acme Storage Battery Corp., Poughkeepsie, N. Y., which recently increased its capital stock from $100,000 to $175,000, has changed its principal product from house-lighting batteries to starting and lighting batteries of the automobile type.

K-B Spotlight Co., Los Angeles, Cal., is having plans prepared by Architect Gordon LeBarr, 500 Stimson building, for a 1-story plant at 3508 South Park avenue. The plant will be equipped for the manufacture of high-power electric lighting apparatus.

Crocker-Wheeler Co., Ampere, N. J., manufacturer of motors, generators, etc., has acquired a large tract of property on Ellington place, East Orange, N. J. It is understood that the company is considering plans to utilize the site as a housing development for its employes service.

Griscom-Russell Co., 90 West street, New York City, has issued a small folder, called "Leaflet No. 6," which in brief form describes the water heaters, oil coolers, oil heaters, evaporators, expansion joints and grease extractors manufactured by the company. The leaflet is profusely illustrated.

Westinghouse Lamp Co., 165 Broadway, New York City, has had plans prepared for the erection of a 4-story building, 80 by 550 ft., at its plant in the Watsessing district of Bloomfield, N. J. The cost of the structure, including equipment, is estimated at about $1,000,000.

Steel City Electric Co., 1207 Columbus avenue, Pittsburgh, Pa., manufacturer of electrical supplies, is having plans prepared for the erection of a 2-story addition to its plant, about 48 by 55 ft., for increased capacity. W. J. Patterson is president of the company.

Wolcott Manufacturing Co., Hartford, Conn., will open a branch factory in Middletown, Conn., for the manufacture of motor-driven washing machines. The company is forced to make this move due to the inability to secure additional quarters in Hartford. The Middletown branch will be in operation April 1.

R. & W. Construction Co., 35 South Desplaines street, Chicago, Ill., has been incorporated by E. C. Rutz and P. E. Widsteen and will specialize in power plant and transmission line construction for public utility and industrial development. Mr. Rutz and Mr. Widsteen were formerly with the Woodmansee-Davidson Engineering Co., Chicago.

E. E. Badger & Sons Co., 63 Pitts street, Boston, Mass., has acquired the American Spray Co., including its essential engineering personnel of men who were pioneers in the spray washing and cooling systems. Bulletins No. 100 and 102 on cooling water and cleaning air by sprays will be sent upon request.

Charles T. Main, Boston, Mass., announces that his organization has been enlarged. Col. F. M. Gunby, who was associated with the office for 15 years before the world war, has returned to his work and has been appointed engineering manager. Other associates in the organization are Fred B. Cole, H. E. Sawtell, J. F. Osborn, W. F. Uhl, Charles R. Main and A. W. Benoit.

Hygrade Lamp Co., Salem, Mass., will add about 20,000 sq. ft. of floor space to its Bridge street storehouse, to meet the demands for additional stocking room and to allow facilities for a modern cafeteria and general assembly room for the employes. Mill construction will be used with wooden walls and asbestos shingles and the storage capacity will be 1,500,000 finished, boxed lamps.

Davis Electric Co., Newark, N. J., has opened a new retail electric appliance store at 15 Central avenue which will be in charge of Charles H. Butler, for many years connected with Newark Electrical Supply Co. The construction department of the Davis company will be continued in the new quarters under the personal supervision of George E. Davis, president of the company.

New York Edison Co., Irving place and 15th street, New York City, is taking bids for the construction of a new 3-story transformer station, about 42 by 75 ft., at 421 East 6th street. The structure, including equipment installation, is estimated to cost about $350,000. The company is also having plans prepared for the erection of new 1 and 2-story reinforced concrete transformer station, about 100 by 200 ft., on 169th street.

Apex Electrical Distributing Co., Cleveland, O., in its sales bulletin for March, is giving electrical appliance dealers a large amount of material to aid them in advertising and selling Apex appliances. The bulletin gives the dealer information as to the national advertising being done by the Apex company and calls attention to the fact that over 2,750,000 reproductions of one Apex advertisement appeared in women's publications in March. Reproductions of this advertisement in various sizes and material for copy and cuts for newspapers, form letters to prospects, folders, envelope enclosures, etc., are shown in the bulletin and such material will be sent free to dealers on application to the Apex company.

Cutter Electrical & Manufacturing Co., 19th and Hamilton streets, Philadelphia, Pa., is sending to the trade a cloth-bound book entitled "Handbook of the 1-T-E Circuit Breaker," which contains full and complete details of all types of apparatus made by the company, together with many illustrations showing pictures of equipment and drawings showing working details. The book, called "Series M" by the company, contains 352 pages and in a foreward it is explained that the book is based on the third edition of "Series K Handbook" brought up to date and revised. In compiling the book the company has kept before it the idea that one reader may be an important consulting engineer versed in every detail of electrical development, while another may be a switchboard attendant or operating engineer, endeavoring to feel his way toward the more skillful or economical operation of the power plant or factory committed to his charge. The book contains a wealth of information for those interested in distribution and operating equipment.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

JOHN REISS, of New Orleans, was elected president of the Louisiana Engineering Society at the annual meeting held recently in New Orleans.

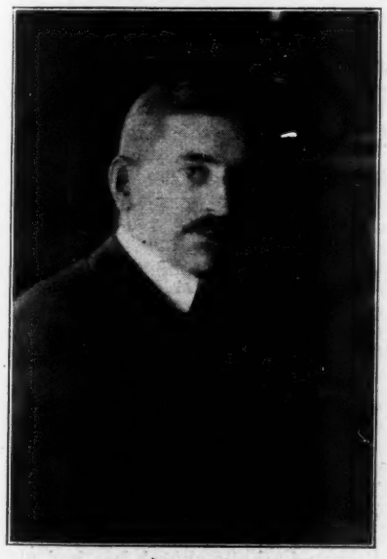
F. S. POVAH, 23 West 43rd street, New York City, has been appointed to act as New York City representative of the Edison Storage Battery Co., West Orange, N. J.

W. W. WATERSON, of Ottawa, Ill., has been appointed traffic manager of the Chicago South Bend & Northern Indiana Railway Co., with headquarters in South Bend, Ind.

J. A. W. BROWN has severed his connection with the Trussed Concrete Steel Co. of Canada, Ltd., and is now chief engineer of the W. H. Yates Construction Co., Ltd., Hamilton, Ont.

ROY W. GROSSETT, Philadelphia, Pa., formerly purchasing agent of the Frank H. Stewart Electric Co., 37 North 7th Street, Philadelphia, has been appointed assistant general manager of the company.

THEODOR SCHOU, formerly professor of electrical engineering at the University of Iowa and later consulting engineer for the Electric Machinery Co., Minneapolis, Minn., is now connected with the Ideal Electric & Manufacturing Co., Mansfield O., in the capacity of chief engineer. Mr. Schou, who has specialized in the design of synchronous motors, being recognized as one of the foremost in this



Theodor Schou.

field, will develop a new line of synchronous machines for the Ideal company, which is enlarging its facilities to include the manufacture of this type of apparatus. During the past few years Mr. Schou has contributed a number of articles on the design and manufacture of synchronous machines to the leading technical periodicals.

WILLIAM YOUNG, for six years comptroller of water rights for the province of British Columbia, has resigned and is now practicing as a consulting engineer in Vancouver, B. C.

WALDO A. LAYMAN, president of the Wagner Electric Manufacturing Co., addressed the St. Louis (Mo.) Electrical Board of Trade at its luncheon on March 23 on "The Industrial Situation in St. Louis."

B. J. DILLON has been appointed advertising manager of the Hurley Machine Co., Chicago, Ill., succeeding B. H. FEARING, who resigned to become advertising manager of the R. H. Donnelley Corp., Chicago, Ill.

H. D. SCHUTE, Pittsburgh, Pa., vice-president of the Westinghouse Electric & Manufacturing Co., has been elected a member of the board of directors of the West Virginia Metal Products Co., Fairmont, W. Va.

ROBERT M. SEARLE has been appointed president of the Rochester (N. Y.) Gas & Electric Corp., to succeed James T. Hutchings, who resigned to become affiliated with the United Gas Improvement Co., Philadelphia, Pa.

C. H. CROOKS, former general manager of the Des Moines, Fort Dodge and Southern Interurban line, was elected president of the company at the annual meeting in Boston, Mass. F. M. JOHNSTON was elected secretary and treasurer.

HARRY C. EDDY, inspector for the Board of Public Utility Commissioners, Trenton, N. J., recently tendered an interesting address on "Street Railway Development" at the meeting of the Men's League, Newark, N. J., on March 15.

C. N. WHEELER, of the Crocker-Wheeler Co., Ampere, N. J., has been active in a number of recent meetings of the Employers' Association of Northern New Jersey, of which he is president, taking a prominent part in discussions relating to problems of the day between employers and employes.

W. A. LODGE, for the past four years with the Underwriters' Laboratories of Chicago, as research engineer, has left that organization and is now connected with the Bussman Manufacturing Co., St. Louis, Mo., in the capacity of research engineer. Mr. Lodge will be in full charge of the engineering department, devoting his time to research and the technical development of the Buss fuse.

ROBERT N. HODGSON has resigned as general manager of the Binghampton (N. Y.) Light, Heat & Power Co., and as general sales manager of the W. S. Barstow Co., to give his time to his own business interests. He is succeeded by R. L. PETERMAN, who was formerly superintendent of the Binghampton company at Easton, Pa.

HARRY N. SESSIONS, chairman of the Membership Committee of the Pacific Coast Section of the National Electric Light Association, and a member of the National Membership Com-

Harry N. Sessions.

mittee, has been making a record in obtaining new members for the organization. Since last November he has obtained approximately 2000 new members in the Pacific Coast Section. Of these new members about 400 are contractor-dealers, jobbers, manufacturers and others engaged in the electrical industry outside of the central-station companies.

OBITUARY.

ARTHUR LEWIS ORMAY, a mechanical engineer of New York City, died of pneumonia, March 23. Mr. Ormay was 39 years of age.

DAVID GRING, Newport, Pa., prominent as a director in numerous public utility companies in Pennsylvania, died on March 20, aged 62 years.

JOHN N. DERBY, vice-president of Manning, Maxwell & Moore, New York City, died of heart disease March 28, at his home in Greenwich, Conn. Mr. Derby was born in Saginaw, Mich., in 1867 and was graduated from the University of Michigan in 1888. He was the inventor of the Hancock inspirator and also of the Metropolitan injector.

CHARLES H. PATRICK, formerly president of the Johns-Pratt Co., manufacturer of fire-proofing supplies, at Hartford, Conn., and for 35 years with the H. W. Johns Co., died on March 20 at his home in New York City. Mr. Patrick retired from business a few years ago.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Fall River, Mass.—A contract has been awarded by the King Philip Mills to the McNally Construction Co., 84 North Main street, for the erection of the proposed new power plant, 1-story brick and concrete, about 48 by 75 ft., to be located on Kilburn street. The structure is estimated to cost about $20,000.

Northhampton, Mass. — Considerable electrical equipment will be required in connection with the construction of the proposed new hospital building, 3-story, 175 by 200 ft., on South street, at the Lathrop Home, estimated to cost about $125,000. Contract for erection has been let to L. A. Sullivan, 353 Prospect street, Northhampton.

Springfield, Mass. — Brightwood Laundry, 44 Converse street, Longmeadow district, has had plans prepared for the erection of a new 1-story laundry plant and boiler house, for increased operations.

Meriden, Conn. — Southern New England Telephone Co., New Haven, is considering plans for the erection of a new telephone exchange plant on West Main street. It is understood that the work will proceed during the coming summer.

Brooklyn, N. Y.—General Insulate Co., 1008 Atlantic avenue, has filed notice with the Secretary of State of an increase in its capital from $50,000 to $250,000, for general business expansion.

Elmira, N. Y.—Willys, Morrow Co., South Main street, has awarded a contract to the Lourman Construction Co., 312 Railroad avenue, for the erection of a new 1-story addition to its boiler plant, about 30 by 70 ft.

Geneva, N. Y.—Arrangements are being made by the Empire Coke Co., operating a gas and coke plant at Border City for service to Geneva, Waterloo, Auburn, Seneca Falls, etc., for extensions in the works, including considerable equipment, estimated to cost about $265,000. The proposed work includes the construction of a new power plant and boiler house to cost about $55,600; carburetted water gas plant, 172,394; new coke handling plant, $33,000; and new gas compressor to cost $4,000.

Herkimer, N. Y.—The Municipal Commission, Michael Foley, president, is understood to be considering plans for the construction of a new 1-story addition to the municipal electric plant, about 40 by 60 ft., as well as the installation of new equipment. The structure will be of brick and steel type, and the entire work is estimated to cost $160,000.

Medina, N. Y.—The Town Council is considering plans for extensions and improvements in the electric street-lighting system in sections of Main street.

New York, N. Y.—At the annual meeting of the stockholders of the Otis Elevator Co., it is planned to vote on an increase in the capital stock from $10,000,000 to $15,000,000.

New York, N. Y.—Worthington Pump & Machinery Corp. has completed negotiations for the leasing of the second and third floors at 321 Greenwich street, to facilitate operations.

Rochester, N. Y.—Rochester Gas & Electric Corp. has commenced foundations for the installation of two new boilers at its Station No. 3, to have a capacity of about 2000 h.p. These units will be equipped with automatic stokers, capable of handling coal screenings and other fine grades of coal. This work will be executed in connection with the proposed expansion of the company's plants and system estimated to cost approximately $750,000.

Rochester, N. Y.—Plans have been arranged by the Eastman Kodak Co. for the erection of extensive new additions to its plant, for increased operations. The work includes the erection of a new concrete and steel power plant for works service, estimated to cost about $199,000, the entire expansion being estimated to cost $500,000. Considerable electrical and mechanical equipment will be required.

Utica, N. Y.—St. Joseph's Infant Home, Sisters of Charity, is considering plans for the erection of a new 2-story laundry building and boiler plant at the institution, located on Green street. The structure will be about 30 by 55 ft., and is estimated to cost $40,000.

Bayonne, N. J.—Standard Oil Co. has had plans prepared for the construction of a new boiler plant at its local works for increased power facilities. The structure is estimated to cost about $89,000.

Butler, N. J.—The Village Electric Light Committee, Samuel K. Owen, treasurer, has arranged for the preparation of plans and specifications for the construction of the proposed new addition to the municipal electric lighting plant. Two 100-kw. electric generating units will be installed, and the entire work is estimated to cost $50,000.

Irvington, N. J.—Kent Manufacturing Co., Grace street, near Nye avenue, has awarded a contract for the construction of a new addition to the boiler plant at its works.

Irvington, N. J.—Lionel Corp., 605 South 21st street, manufacturer of electrically operated toys, etc., will inaugurate work at an early date on the construction of a new 4-story factory building, about 75 by 82 ft. The plant is estimated to cost about $50,000.

Mays Landing, N. J.—Mays Landing Water & Power Co. has awarded a contract to the Aberthaw Construction Co., School street, Boston, Mass., for the construction of a new 1-story power plant of reinforced concrete, estimated to cost about $50,000. The structure will be 40 by 40 ft.

Newark, N. J.—Public Service Electric Co. has awarded a contract for piping in connection with extensions in its Point No Point power station for increased service. This piping work is estimated to cost $13,892.

Newark, N. J.—Brown & Hunkele Corp., manufacturer of motors, and operating a local motor repair works at 12 Mechanic street, has had plans prepared for alterations and improvements in its electric shop at 24 Mechanic street, to facilitate operations.

Trenton, N. J.—Western Union Telegraph Co. has filed application with the City Commission for permission to install an underground conduit system on West Hanover street, from Warren to Calhoun street, to replace the present overhead system.

Brownsville, Pa.—Rice Brothers have awarded a contract to the Brownsville Construction Co., Brownsville, for the erection of a new 2-story and basement laundry building, estimated to cost about $25,000.

Easton, Pa.—Pennsylvania Pump & Compressor Co. has had plans prepared for the construction of a new 1-story foundry, about 80 by 100 ft., to be located in the Bushkell district. The structure is estimated to cost about $20,000.

Johnstown, Pa.—Women's Memorial Hospital Association has awarded a contract to C. Schenkemeyer & Son, Johnstown, for the erection of a new 4-story power plant and laundry building at the institution, about 160 by 163 ft.; estimated to cost $40,000.

Marcus Hook, Pa.—Viscose Co., manufacturer of artificial silk, has taken bids for the construction of a new 3-story brick boiler plant at its works, for increased power facilities. The structure will be about 53 by 108 ft.

Philadelphia, Pa.—St. Boniface's Roman Catholic church has had plans prepared for the construction of a new addition to its boiler plant at Mascher and Diamond streets.

Philadelphia, Pa. — Sears-Roebuck Co., Chicago, Ill., has awarded a contract to Irwin & Leighton, 126 North 12th street, for the erection of its proposed new 1-story brick and con-

crete power plant, about 151 by 180 ft., to be erected in conjunction with the proposed new local plant of the company. The building will be located on Roosevelt boulevard, near Adams street, and is estimated to cost, including machinery and equipment, about $400,000.

Philadelphia, Pa.—City Water Department is taking bids for the construction of a new 1-story brick and stone intake house, about 30 by 55 ft., at the Queen Lane pumping station.

Pittsburgh, Pa.—Power Piping Co., foot of Beaver avenue, Northside district, has been awarded contract for the installation of piping system in several of the large all steel cargo barges now in course of construction by the Dravo Contracting Co. and the American Bridge Co.

Pittsburgh, Pa.—J. K. Davison & Brother Sand Co. is planning for the immediate installation of the electrically operated machinery and equipment on its various vessels to be used for sand digging operations. This will replace the steam motive power at present utilized.

Baltimore, Md. — Chesapeake & Potomac Telephone Co. has had plans prepared for enlarging its switchboard and cable facilities throughout the entire city limits, for increased and improved service.

Baltimore, Md.—The Water Department is making a broad investigation of the subject of electrolysis in connection with the city water supply lines. A report is now being compiled by Water Engineer Megraw in connection with this matter. According to the statement of V. B. Siems, engineer in charge of distribution of the municipal water supply, the basic remedy consists of "a double trolley system rather than a single trolley system as now used by the local railway company."

Thurmont, Md.—Plans are under consideration by the town officials for a bond issue of $5000 for improvements in the municipal electric light plant.

Towson, Md.—Considerable electrical and mechanical equipment will be required in connection with the construction of the proposed new 2-story publishing plant of the Baltimore City Printing & Binding Co, Equitable building, Baltimore, at Towson, Md. The plant is estimated to cost about $40,000.

Washington, D. C.—Washington Gas Light Co. is understood to be considering plans for the establishment of a large new coal gas plant on Analostan island, to have a capacity of about 10,000,000 cu. ft. daily, and will include the construction of a bridge from Rosslyn to Analostan island, with extensive freight terminal facilities. Large quantities of electrical and mechanical equipment will be required in connection with the project which is estimated to cost close to $3,000,000. H. S. Reeside is the president of the company.

Richmond, Va.—Virginia Central Telephone Co., operating in Buckingham county, is understood to be considering improvements in its facilities and service. The company has been granted permission by the State Corporation Commission to increase its rates for service.

Charleston, W. Va.—United States Government, Bureau of Yards & Docks, has completed plans for the construction of a new electric substation at its local properties. The structure is estimated to cost about $40,000.

Tarboro, N. C.—Rodhill Power Co., recently incorporated with a capital of $250,000, has perfected its organization and is arranging for the construction of a large local electric power station estimated to cost in excess of $130,000.

NORTH CENTRAL STATES.

Ashland, O.—The Rybolt Heater Co. has increased its capital stock from $100,000 to $200,000 and plans the erection of additions, including a 2-story structure, 66 by 129 ft.

Cincinnati, O.—The Linde Air Products Co. will build a branch in the Bond Hill section at a cost of $150,000 on new buildings and equipment.

Cincinnati, O.—The Northside Motor Co. has let a contract for the construction of a 1-story plant, 40 by 100 ft., to cost $16,000. Werner & Adkins are the architects.

Cleveland, O. — The Champion Forge & Machine Co., East 71st street and Union avenue, has awarded the contract for the construction of a 3-story, 60 by 120 ft., factory to the Charles Petersen Co., 4500 Euclid avenue. The factory will cost $100,000.

Gary, Ind.—The National Spring Products Co., which is just completing a new factory building, is having plans prepared for another 4-story structure that will cost $500,000.

Kokomo, Ind. — The Pittsburgh Plate Glass Co. has awarded the contract for the construction of a 12,000-kw. steam-power station to Stone & Webster, 120 Broadway, New York City.

Chicago, Ill.—The Chicago Faucet Co., 2712 North Crawford avenue, will build a 1-story addition to its plant, 50 by 125 ft., to cost about $60,000. A. C. Brown is president of the company.

Chicago, Ill.—The Columbia Scale Co., 2439 North Crawford avenue, is receiving bids on a 1-story plant, 100 by 125 ft., to cost $35,000.

Chicago, Ill.—The Advance Spring & Wire Co., 1749 Carroll street, will erect a 2-story plant, 120 by 123 ft., at Carroll avenue and Wood street. The new plant will cost $125,000.

Peoria, Ill.—The Automatic Carbonic Co. has increased its capital stock from $15,000 to $200,000.

Grand Rapids, Mich.—W. H. Spears will build a 3-story, 50 by 100 ft., factory. Steam heating equipment and motors for power will be installed in the building at a total estimated cost of $80,000. Pierre Lindhout, architect, 817 Lake drive, is in charge of the construction work.

Marysville, Mich.—Smith Hinchmann & Grylls, architects and engineers, 710 Washington arcade, Detroit, will soon award contracts for the construction of a 1 and 2-story, 380 by 420 ft., foundry at Marysville, for the General Aluminum & Brass Co., of Detroit. Steam and hot blast heating equipment and motors for power will be installed in the foundry, the building and equipment being estimated to cost $500,000.

Muskegon, Mich. — The Shaw-Walker Co., manufacturer of metal filing equipment, is taking bids for an addition to its plant, 30 by 90 ft., to cost about $200,000, including equipment. C. E. Wilson is secretary of the company.

Pontiac, Mich.—Grand Trunk Railway system plans to build a 1-story roundhouse with a capacity of 50 engines. Electric power will be installed in the roundhouse. F. P. Sissons, division engineer, Brush street depot, Detroit, Mich., is in charge of the improvement.

Algoma, Wis.—The city water and light plant plans to purchase energy from the Wisconsin Public Service Co., Green Bay, and construct a 63-mi., 66,000-volt, three phase, 60 cycle, transmission line. E. P. M. McCarthy is superintendent of the plant.

Amery, Wis.—The Apple River Milling Co. plans to construct a 39-mi., 22,000-volt, transmission line. W. R. Haney is superintendent of the company.

Minneapolis, Minn.—Jacob Resler, 27 4th street, north, will soon award the contract for the construction of a 3-story addition, 97 by 110 ft., at an estimated cost of $160,000. F. Van Antwerp, 416 Palace building, is the architect.

Minneapolis, Minn.—The Russell Grader Co., 2037 University avenue, S. E., is completing plans for a new 1-story plant, 425 by 600 ft., to cost about $250,000, including equipment.

St. Paul, Minn.—The Willys-Overland Co., Toledo, O., is arranging for the erection of a 1-story assembling plant, 200 by 300 ft., on Eustis avenue, St. Paul.

Flandreau, S. D.—The Dakota Light & Power Co. plans to construct extensions to transmission lines. A. H. Bushman is superintendent of the company.

Highmore, S. D.—The municipal electric light and power plant plans to change its generating system from direct-current to alternating-current. A. H. Fehr is superintendent of the plant.

Bolivar, Mo.—The city is arranging plans for improvements in the municipal electric plant, including the installation of new generating equipment, for increased service. A. F. Leavitt is light and water commissioner.

Fulton, Mo.—The municipal electric light and water works plans to install a new 250-kw. unit, including engine and generator. W. J. McCarroll is the superintendent of the plant.

SOUTH CENTRAL STATES.

Lexington, Ky.—The new plant of the Hemp Co. of America to be located on a 5-acre tract recently acquired, will include machine shop, power plant and a number of other

buildings. The new works are estimated to cost $150,000, including machinery. R. D. Jenkins is president of the company.

Livermore, Ky.—The Green River Chair Co. has let contracts for three new buildings and will install new wood-working machinery.

Louisville, Ky.—The Badger Aluminum Co. has increased its capital stock from $25,000 to $50,000.

Memphis, Tenn.—The Dugger & Goshorn Co. is planning the erection of a factory for the manufacture of plow handles and kindred specialities. J. G. Goshorn is general manager of the company.

Memphis, Tenn.—Southern Automobile Manufacturing Co., 117 Linden avenue, will erect a $250,000 plant. Regan & Weller, Bank of Commerce building, are the architects.

Cedar Grove, La.—Louisiana Motor Car Co. is planning the erection of an addition for general production. A second extension is also proposed for the manufacture of parts. The company recently increased its capital stock from $1,000,000 to $3,000,000. W. F. French is president and manager of the company.

West Monroe, La.—The city has approved the issuance of bonds for $25,000, the proceeds to be used for the construction of new municipal electric power plant and water system.

New Orleans, La.—The Appalachian Corp. will expend about $600,000 on mechanical equipment, including conveyor system and other machinery. Louis B. Magid is president of the company.

Magnolia, Ark.—The Consumers Ice & Light Co. is in the market for a 450-hp. engine direct-connected to generator.

Pine Bluff, Ark.—The Pine Bluff Iron Works is reported to be in the market for about $10,000 worth of equipment. M. Schnable is president of the company.

Altus, Okla.—The municipal water and light department will install an additional 700 kv-a. generator with high-pressure boilers. Charles H. Welch is superintendent of the plant.

Enid, Okla.—City is having plans prepared by Black & Veatch, engineers, Interstate building, Kansas City, Mo., for the construction of a large new power house and electric lighting system, for municipal service. The project is estimated to cost close to $500,000.

Lima, Okla.—The Lima Gin & Investment Co. is in the market for about $10,000 worth of machinery.

McAlester, Okla.—Earl J. Baker and others will equip a machine shop at a cost of about $75,000, including machinery.

Weatherford, Okla.—Plans have been arranged by the City officials, G. A. Griechfield, manager, for extending the municipal transmission lines approximately nine miles, for increased service.

WESTERN STATES.

Prineville, Ore.—The board of directors of the Ochoco Irrigation District plans to vote an additional $100,000 in bonds for the completion of the Ochoco dam and for the construction of distributing system structures, including pumping plant, office building and warehouse. The total estimated costs of the improvements is $1,350,000.

Corning, Cal.—The Corning Box Co. is planning the erection of a 2-story plant to cost about $100,000, including equipment. E. A. Shook and W. N. Woodson head the company.

Los Angeles, Cal.—The Batchelder Tile Co., Story building, has filed plans for the erection of a 1-story plant, 125 by 150 ft., to cost $11,000.

Los Angeles, Cal.—The Byron Jackson Iron Works, of San Francisco, will erect a branch in Los Angeles, 50 by 100 ft., at a cost of approximately $100,000.

Sacramento, Cal.—The California Packing Co., 6th and G streets, is having plans prepared for the construction of a 2-story packing house and 1-story boiler house, at a total estimated cost of $80,000. Philip Bush, 101 California street, San Francisco, is the engineer on the project.

San Francisco, Cal.—The Commercial Union Assurance Co., Ltd., and the California Fire Insurance Co., 558 Sacramento street, has awarded the contract for the erection of a 15-story office building on Pine and Montgomery streets to the Walker Construction Co., Monadnock building, San Francisco. The estimated cost of the building is $1,000,000.

Porterville, Cal.—The Ulmer Machinery Co. is erecting a machine shop at a cost of $25,000.

INCORPORATIONS

New York, N. Y.—Champion Storage Battery Corp. Capital, $50,000. To manufacture electric storage batteries. Incorporators: L. S. Cohen, G. Davis, and L. M. Samuel, 610 West 115th street.

New York, N. Y.—Robert Elkan Electric Co. Capital, $10,000. To manufacture electrical goods. Incorporators: C. G. Widman, R. Elkan, and E. Pollan, 6 East 107th street.

New York, N. Y.—Pyramid Winding & Electric Corp. Capital, $20,000. To manufacture electrical specialties. Incorporators: H. Cowan, E. O. Thomas, and J. M. Poss, 149 Broadway.

New York, N. Y.—Radio Corp. of South America, incorporated under Delaware laws Capital, $10,000,000. To operate wireless telegraph and telephone systems. Incorporators: Harry C. Hand, Samuel B. Howard, and Robert K. Thistle, New York.

Kingston, N. Y.—Aemile Bachelet Corp. Capital, $150,000. To manufacture electric generating machinery, etc. Incorporators: R. E. Smith, E. Bachelet, and C. R. Cummings.

Elizabeth, N. J.—Franklin Appliance Co. Capital, $50,000. To manufacture and deal in electrical goods. Incorporators: Frank and A. D. Stout, and C. L. Higsy, Plainfield, N. J.

Washington, D. C.—American Accumulator Co. Incorporated under Delaware laws. Capital, $500,000. To manufacture batteries, etc. Incorporators: Louis A. Miller, Arthur E. Marsh, Abraham Eisner, Washington, D. C.

Halethorpe, Md.—Atlas Electro-Chemical Co. Capital, $300,000. Incorporators: Henry Herbert, Andrew Westervelt, and Joseph Goldsmith.

Petersburg, Va.—Electric Tool Manufacturing Co. Capital, $200,000. To manufacture electric tools, etc. Incorporators: W. H. Poole, and C. W. Sutherland.

Jackson, Miss.—Jackson Public Service Co. Capital, $600,000. To operate an electric power plant and distribution system. Incorporators: Joseph H. Brewer, Charles McPherson, and Blaine Gavett, all of Grand Rapids, Mich.

Los Angeles, Cal.—Bids will be received until 3 p. m., April 6, by the Board of Public Service, Knickerbocker Building, for furnishing a quantity of electric generators, transformers, auxiliary electric equipment, hydraulic equipment, etc., in accordance with Specification No. P-221. James P. Vroman is secretary.

Newark, N. J.—Essex Lighting Fixture Co. has filed notice of organization to operate at 206 Springfield avenue for the manufacture of lighting fixtures. Bernard Panitch, 470 Bergen street; and A. Meister, 92 Bragaw avenue, head the company.

Bayonne, N. J.—Standard Electrical Supply Co. has filed notice of organization to operate at 566 Avenue C for the production of electrical supplies. Max Swift, 91 West Seventeenth street; and William Linder, 566 Avenue C, head the company.

Huntington, Ind.—Huntington Electric Co. has been incorporated with capital stock of $15,000. Harry C. Mitten, Harry E. Helm and Edward Correll are the incorporators.

PROPOSALS

Electric Light and Power Plant Machinery—Bids for machinery and material required for the new electric light and power plant at the Harbor Works, Valparaiso, Chile, South America, will be received at the office of the Commissioner of Ports at San Diego, Chile, on June 15, 1920. A large quantity of equipment will be utilized in connection with the project. Specifications and plans are on file at the office of the Consul General of Chile, 165 Broadway, New York City.

Lightning Plant—The United States Government Treasury Department at Charleston, S. C., will receive bids until April 15, for the installation of a new lighting plant and water supply system at the United States quarantine station, Charleston.

Production—How It Can Best Be Stimulated

The volume of production in the United States depends upon many factors, the principal ones being the volume of demand, capacity of plant in its broadest sense, efficiency of plant equipment, and efficiency of labor.

PRODUCTION LESS THAN DEMAND

It is a matter of common knowledge that production at the present time is not equal to the demand and this may be the result of an extravagant or an unusual demand, or of inefficient labor or of both, because I think it may be assumed that our National plant has ample capacity and is efficiently equipped.

That there is an extravagant demand is the daily observation of the average man and the demand for luxuries undoubtedly operates to curtail to some extent the supply of necessaries, but I will not take up any of your time to discuss that feature because it has little or no bearing on the question of productive efficiency.

That there is a let-down in the efficiency of labor is asserted by most employers, although there are no statistics which cover the industrial field thoroughly enough to furnish undeniable proof.

The industries which show an exception to the general experience of employers so far as they have come to my attention are those in which the output is largely governed by the speed of automatic machines.

THE CAUSES

Many reasons are given for the present world-wide inefficiency and industrial unrest and many remedies proposed, many of which start with the assumption that there is something wrong with our present industrial system.

There appears to be a wide-spread belief that it does not yield the greatest prosperity to the greatest number and that it should be democratized.

I assume that to mean that the line which now divides labor and capital should be more or less obliterated by giving labor more or less control over some of the functions heretofore assigned to capital.

The discussion of this great problem is rendered difficult by the general tendency to introduce a sentimental or moral issue into an economic problem.

NATIONALIZATION OF INDUSTRY WRONG

If the people would be better off by the abolishment in part or the whole of private capital and the establishment of a community control and operation of industry in whole or part, it would not be because of the operation of any moral or sentimental right, but because it is a sound economic system; and, if I believed nationalization of industry to be a sound economic system, I would not contend against it; but I know it is utterly wrong and impossible of achievement.

Nevertheless, it is preached broadcast and a large number of people do believe in these theories and vainly hope for that which is impossible. Without doubt this now contributes to unrest and will continue to do so unless at some future time sound education chases away this will-o'-the-wisp.

A QUESTION OF CONDITIONS

The question simply is, under what conditions will the productive effort of the people be the greatest, and the greatest prosperity come to the greatest number?

I believe those conditions will be most nearly reached under a system which permits capital to take the risk and the profits remaining after providing for as liberal a wage as the production and traffic of the Nation will bear, and which at the same time furnishes an opportunity for each individual worker who has the ambition and the ability to profit thereby, to improve his status in the community and to accumulate property of his own.

If this be true, anything that tends to support such a system is beneficial and anything which tends to weaken it is harmful.

I think it is obvious that without some restraining influence upon selfish interests of the employer there would be a tendency to pay a lower wage than the traffic would bear and that this fact is a solid foundation upon which law-abiding and responsible labor unions may safely rest.

I also think it equally obvious that complete unionization of labor would create an organized selfish power which would reduce production, and thus reduce our standard of living which depends almost solely on production, and distribute workmen into classes and fix them there, thus practically destroying the opportunities for the ambitious man with ability.

We can see in England a very complete organization of labor, production at a low point, and the tendency to breed classes who are satisfied to remain in the station of life occupied by their fathers and grandfathers.

The problem appears to me to be one that is not to be solved by radical changes in our industrial system but by maintaining a proper equilibrium between the self interest of capital on the one hand and the self interest of labor on the other to the end that too great power shall not be given to either.

If this can be accomplished at all, it will only be done by permitting a healthy play of natural forces. A man should be entirely free to belong to a labor union or not, as he pleases, and in this right he should have the full protection of the law. Likewise an employer should be entirely free to run an open shop or a closed shop, as he pleases, and he should be protected in that right.

The above is excerpted from an address by Gen. Guy E. Tripp, President of the Board of Directors of the Westinghouse Electric and Manufacturing Company, which was recently made before the Merchants' Association of New York. It is terse, vigorous and right to the point. C. A. TUPPER, President International Trade Press, Inc., Chicago.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Chicago Surface Railway Lines Show Big Gain in Earnings.

Gross earnings of the Chicago Surface Railway lines for the fiscal year ending Jan. 31, 1920, were $43,417,639, an increase of $9,253,341, or 26.6% compared with the previous year.

The increase in gross was due to the increase in fares granted Aug. 8, 1919. While gross showed the expansion noted, there was an increase in operating expenses of $7,522,077, which is attributed to the increase in wages.

The city of Chicago profited by the increase in fares. Its share of the net earnings in the previous fiscal year from one of the companies, the Chicago City Railway, was only $5,857. This year the City Railway Company will pay the city $443,588. The Chicago Railways Co. has not made up its report yet, but it will pay a still larger sum.

Pennsylvania Utility Companies Plan Bond Issues.

Extensive expansion plans are under consideration by numerous public utilities companies throughout Pennsylvania, and notices of large intended bond issues have been filed with the Public Service Commisison. Among these are: Reading Transit & Light Co., Reading, bonds, $1,911,500; Counties Gas & Electric Co., Philadelphia, bonds, $197,000; Sayre Electric Co., Sayre, bonds, $7500; Penn Central Light & Power Co., Altoona, bonds, $247,0000, and $144,000; Eastern Pennsylvania Railways Co., Pottsville, bonds, $108,000, and notes, $7,000; Pittsburgh & Shamut railroad, Kittanning, notes, $1,500,000; Pennsylvania Utilities Co., Easton, bonds, $87,000; Trenton, Bristol and Philadelphia Street railway, Philadelphia, car trust certificates, $27,742.27; Metropolitan Edison Co., Reading, bonds, $59,500; Citizens Traction Co., Oil City, bonds, $92,000; Citizens' Light & Power Co., Oil City, bonds, $14,000; and Chester Valley Electric Co., Coatesville, bonds, $41,000.

Western Electric Co. Sells $25,000,000 in Bonds.

The Western Electric Co. has sold to a syndicate headed by Lee, Higginson & Co. and the Chase Securities Corp., of Boston, $25,000,000 five-year 7% convertible gold bonds, due April 1, 1925, convertible at the option of the holder at any time between April 2, 1922, and Oct. 1, 1924, into the 7% cumulative preferred stock of the company, par for par.

Merchants Heat & Light Co. to Issue $266,000 in Bonds.

The Indiana Public Service Commission has authorized the Merchants Heat & Light Co., Indianapolis, Ind., to issue $220,000 10-year 5% bonds at not less than 85% of par and $46,000 common stock, to reimburse the treasury for the purchase of the capital stock of the Ayrdale coal mine. The commission denied the petition of the ccmpany to issue $12,900 additional stock to refund interest on deferred payments in the purchase of the capital stock in the mine.

New England Co. Power System.

Earnings of the New England Co. Power System for January and the 12 months ended Jan. 31, 1920, compare with 1919 as follows:

	1920.	1919.
January gross .....$	483,238	$ 318,033
Net after taxes	133,160	130,786
Surp. after int. chgs.	66,843	66,071
12 months' gross	4,284,179	3,612,955
Net after taxes	1,514,461	1,400,806
Surp. after int. chgs.	740,154	721,118

Public Service Corporation of New Jersey.

The balance sheet of the Public Service Corporation of New Jersey, as of Dec. 31, 1919, compares as follows:

ASSETS.

	1919.	1918.
Total .....$	126,563,829	$123,896,474
Treasury bonds ..	12,500,000	12,500,000
Sinking fund, etc..	2,399,145	2,459,479
Cash	240,066	365,020
Accounts receivable	12,014	10,788
Int. and divs. rec..	245,994	175,345
Deferred charges .	4,305,322	3,908,754
Investments .....$	106,861,288	$104,477,088

LIABILITIES.

Preferred stock ...$	10,057,400	.....
Common stock	29,999,600	$ 29,999,600
Bonds	82,493,370	77,550,770
Adv. fr. oth. cos...	.....	4,000,000
Bills payable	45,000	7,111,000
Accrued taxes	17,669	3,338
Accrued interest .	950,546	883,111
Other accrued	102,321	102,633
Accounts payable .	23,559	2,025
Reserves	455,828	833,132
Surplus	2,418,535	3,410,865
Total .....$	126,563,820	$123,896,474

Columbia Gas & Electric Co.

Earnings of the Columbia Gas & Electric Co. for February and the two months ended Feb. 29, 1920, compare with 1919 as follows:

	1920.	1919.
February gross .....$	1,348,503	$1,100,555
Net after taxes	739,942	581,964
Total net income	949,669	746,670
Surp. after fixed chgs.	543,482	393,192
2 months' gross	2,750,384	2,289,393
Net after taxes	1,511,772	1,202,671
Total net income	1,929,859	1,533,828

Southwestern Power & Light Co.

Earnings of the subsidiaries of the Southwestern Power & Light Co. for December and the 12 months ended Dec. 31, 1919, compare with 1918, as follows:

	1919.	1918.
December gross .....$	717,698	$ 571,988
Net earnings	350,938	233,022
12 months' gross	6,482,819	5,691,777
Net earnings	2,398,095	2,102,846

Tennessee Power Co.

Earnings of the Tennessee Power Co. for January and the 12 months ended Jan. 31, 1920, compare with 1919 as follows:

	1920.	1919.
January gross .....$	204,837	$ 221,788
Net after taxes	101,264	103,030
12 months' gross	2,149,937	2,300,370
Net after taxes	858,493	922,296

Dividends.

The Massachusetts Lighting Companies declared a dividend of $1.50 a share on the preferred stock, payable April 15 to stockholders of record March 25.

The Kansas Gas & Electric Co. has declared its regular quarterly dividend of 1¾% on the preferred stock, payable April 1 to stockholders of record March 20.

The Pan-American Power & Light Corp. has declared its regular quarterly dividend of 1¾% on the preferred stock, payable April 1 to stockholders of record March 18.

The West Penn Traction & Water Power Co. has declared its regular quarterly dividend of 1½% on the preferred stock, payable April 1 to stockholders of record March 25.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Mar. 23.	Bid Mar. 30.
Adirondack Electric Power of Glens Falls, common	6	11	11
Adirondack Electric Power of Glens Falls, preferred	6	77	77
American Gas & Electric of New York, common	10+extra	125	126
American Gas & Electric of New York, preferred	6	38	38½
American Light & Traction of New York, common	..	188	187
American Light & Traction of New York, preferred	6	89	89
American Power & Light of New York, common	4	65	65
American Power & Light of New York, preferred	6	68	67
American Public Utilities of Grand Rapids, common	..	4	5
American Public Utilities of Grand Rapids, preferred	7	15	16
American Telephone & Telegraph of New York	..	100½	102
American Water Works & Elec. of New York, common	..	3	4
American Water Works & Elec. of New York, particip	7	8	8
American Water Works & Elec. of New York, first preferred	..	45	45
Appalachian Power, common	..	2	3
Appalachian Power, preferred	7	19	20
Cities Service of New York, common	+extra	385	388
Cities Service of New York, preferred	6	70	70
Commonwealth Edison of Chicago	8	106	105
Comm. Power, Railway & Light of Jackson, common	..	18	18
Comm. Power, Railway & Light of Jackson, preferred	6	39	42
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	43	45
Middle West Utilities of Chicago, common	..	18	18
Middle West Utilities of Chicago, preferred	..	39	39
Northern States Power of Chicago, common	..	50	50
Northern States Power of Chicago, preferred	ex.div.7	87	87
Pacific Gas & Electric of San Francisco, common	..	48	49
Public Service of Northern Illinois, Chicago, common	7	78	78
Public Service of Northern Illinois, Chicago, preferred	6	83	83
Republic Railway & Light of Youngstown, common	4	17	17
Republic Railway & Light of Youngstown, preferred	6	54	54
Standard Gas & Electric of Chicago, common	..	20	19
Standard Gas & Electric of Chicago, preferred	6	40	39
Tennessee Railway, Light & Power of Chattanooga, common	..	1½	2
Tennessee Railway, Light & Power of Chattanooga, preferred	6	6	6
United Light & Railways of Grand Rapids, common	4	25½	25
United Light & Railways of Grand Rapids, preferred	6	63	63
Western Power of San Francisco, common	..	17	17
Western Union Telegraph of New York	extra	70	80
Industrials—			
Electric Storage of Philadelphia, common	4	105	105
General Electric of Schenectady	8	170	170
Westinghouse Electric & Mfg. of Pittsburgh, common	7	52	52